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THE

MALAYAN AGRICULTURAL JOURNAL

PRINCIPAL CONTENTS

CONSTRUCTION OF COASTAL BUNDS IN MALAYA. D. S. Ferguson, B.Sc., M.I.C.E., A.M. AM. SOC. C.E.

PADI MANURIAL AND CULTURAL TRIALS IN THE 1949-50 SEASON. E. F. Allen, B.A., DIP. AGR. SCI. (CAMB.), A.I.C.T.A.

NOTES ON THE CONTROL OF TREES AND WEEDS BY PHYTOCIDES. T. A. Buckley, M.Sc., PH.D., F.R.I.C.

A REVIEW OF PROGRESS RECORDED IN THE UP-GRADING AND BREEDING OF PEDIGREE IMPORTED AND LOCAL GOAT. G. S. Keeping, B.Sc., DIP. AGR. SCI. (CAMB.).

MECHANIZATION. QUARTERLY PROGRESS REPORT, OCTOBER TO DECEMBER, 1950.

NOTES ON CURRENT INVESTIGATIONS, OCTOBER TO DECEMBER, 1950.

DEPARTMENT OF AGRICULTURE, FEDERATION OF MALAYA.

Kuala Lumpur.

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Pages

EDITORIAL 1

ORIGINAL ARTICLES.

CONSTRUCTION OF COASTAL BUNDS IN MALAYA.
D. S. Ferguson, B.SC., M.I.C.E., A.M. AM. SOC. C.E. 3

PADI MANURIAL AND CULTURAL TRIALS IN THE 1949-50 SEASON.
E. F. Allen, B.A., DIP. AGR. SCI. (Camb.), A.I.C.T.A. 13

NOTES ON THE CONTROL OF TREES AND WEEDS BY PHYTOCIDES.
T. A. Buckley, M.SC., PH.D., F.R.I.C. 27

A REVIEW OF PROGRESS RECORDED IN THE UP-GRADING AND BREEDING OF PEDIGREE IMPORTED AND LOCAL GOAT.
G. S. Keeping, B.SC., DIP. AGR. SCI. (Camb.). 32

MECHANISATION. QUARTERLY PROGRESS REPORT, OCTOBER TO DECEMBER, 1950. 40

NOTES ON CURRENT INVESTIGATIONS, OCTOBER TO DECEMBER, 1950 44

DEPARTMENTAL.

DEPARTMENTAL NOTES 49

STATISTICAL.

MARKET PRICES, OCTOBER TO DECEMBER, 1950. 51

PRODUCTION OF PALM OIL AND KERNELS, FEDERATION OF MALAYA. 53

MALAYAN AGRICULTURAL EXPORTS, JULY TO SEPTEMBER, 1950. 53

RUBBER PRODUCTION, FEDERATION OF MALAYA. 54

COPRA AND COCONUT OIL STATISTICS, FEDERATION OF MALAYA. 55

METEOROLOGICAL SUMMARY, OCTOBER, 1950. 56

METEOROLOGICAL SUMMARY, NOVEMBER, 1950. 57

METEOROLOGICAL SUMMARY, DECEMBER, 1950. 58

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JANUARY, 1951

EDITORIAL

Drainage and Irrigation. The principal functions of the Drainage and Irrigation Department can be summarised as follows:—

(a) The improvement of irrigation and drainage facilities in existing padi areas with a view to increasing yields which will add to the rice production of the country and at the same time improve the conditions of the rural community.

(b) The development of new padi areas for smallholder settlement, or for cultivation by mechanical means, for increasing rice production.

(c) The construction and maintenance of drainage schemes for other agricultural crops.

(d) The conservancy of the rivers which are the natural drainage arteries of the country.

Irrigation, because of the nature of the works required for the control of water, is now universally recognised as a special branch of civil engineering, but the object of irrigation remains agricultural. In the attainment of the object in this country, close co-operation is maintained with the officers of the Department of Agriculture. In the course of developing, by research and experimentation a suitable irrigation technique for application in Malaya, much information has been and will be obtained which can be of use to those engaged in agricultural pursuits. It is therefore proposed, from time to time, to publish such information in this Journal. The first article, by Mr. Ferguson, on the construction of coastal bunds, appears in this issue.

Padi Manurial and Cultural Trials. The Department of Agriculture is endeavouring to improve padi yields in a number of ways, the most important being the selection and breeding of improved varieties, the use of fertilisers, improved methods of cultivation and the control of pests and diseases. The article by Mr. Allen describes the work carried out during the 1949-50 padi season in respect of manurial and cultivation experiments and brings up to date the information in respect of those which have been planned to run for a number of years. The use of fertilisers in other rice-growing countries has considerably increased yields but the effects of their use in Malaya have, up to now, been largely negative. During the season under review, however, there

were certain positive indications, more particularly in the East Coast padi areas, which have been used as a basis for planning the series of experiments for the 1950-51 season. This current series is an extremely comprehensive one and involves techniques of application not previously followed on any scale in Malaya.

Phytocides. There is a demand in this country for plant poisons for the destruction of trees, both when clearing jungle for the planting of crops and when removing old stands of tree crops to enable replanting to be carried out, and of weeds, both on dry land and in padi fields and water courses. The article by Dr. Buckley gives an account of the applicability in this country of certain herbicides, arboricides and plant defoliants as determined to date by the Department of Agriculture.

Goat Keeping. One aspect of the livestock programme of the Department of Agriculture embraces investigations into the upgrading of the goat population of Malaya. This has involved, initially, the importation of pedigree animals from Europe. The article by Mr. Keeping gives some account of these importations and of the progeny resulting from their crossing with local animals, up to the present. The work to date, although on a small scale, has had encouraging results and it will be extended as soon as the staffing position of the Department permits.

CONSTRUCTION OF COASTAL BUNDS IN MALAYA

BY

D. S. FERGUSON,

Deputy Director, Drainage and Irrigation Department.

Prevalent Conditions in Coastal Areas.

The construction of bunds to prevent the ingress of sea-water is a necessary preliminary to the successful agricultural development of the fertile coastal areas of the Malay Peninsula facing the Straits of Malacca. Generally these areas are, under natural conditions, covered with mangrove swamp forests and the ground levels are below high tide levels. The soil is clay, firm on the surface and to depths down to 30 ins., but below that is generally semi-liquid mud. When the agricultural development of Malaya, away from the Malays' riverine *kampongs*, * started towards the end of the last century, these coastal lands were opened up for cultivation of coconuts, sugar and rice and, later, rubber, and the first job done was to have bunds constructed to keep sea-water off the land. The tidal range is not uniform along the west coast of the peninsula and the following are the maximum ranges at the autumnal equinoxes for various parts along that coast:

Penang	8 ft.
Port Swettenham	17 ft.
Port Dickson	10 ft.
Johore Straits	12 ft.

Ground levels vary between † R.L. 4 and R.L. 8 and the earth bunds have to be constructed up to 7 ft. in height to keep out sea-water. Generally speaking, however, the high tide levels at any place bear a relationship to normal ground levels at that place and, to protect land suitable for agriculture, the bunds need seldom be built more than 4 to 5 ft. in height.

Construction of Bunds by Manual Labour.

Prior to 1934, the bunds were constructed by hand labour and, at first, the general practice was to dig a drain on the inside of the bund-site and use the spoil obtained therefrom for building the bund. Later, when settlement of the bund occurred, spoil was obtained for raising bund levels again by digging a burrow-pit adjacent to the bund on the sea-ward side. (See Sketch No. 1, Appendix A). The result was that the bund foundations were continually waterlogged, and boring crabs found conditions ideal for their way of life; slips and breaches were continuous, maintenance charges were heavy, damage of crops by entry of salt water common, and it became, as the years passed by, more and more difficult to find spoil for closing breaches in emergencies and topping up the bunds as a work of routine maintenance. European-owned estates maintained their bunds either individually or by joining Government controlled and maintained drainage areas. Smallholders' lands, however,

* Villages. † R.L. = Reduced Level.

were, unless situated in a Drainage Area, inadequately protected and large acreages went out of cultivation. The Sabak Bernam Peninsula, though protected by a bund built by Government, was largely abandoned by 1932 and the land was valueless; the bund was in bad repair and breached in many places. In 1933, when the Sabak Peninsula bund was to be reconstructed, it was decided to have no drain parallel to the bund on the inside but to have the burrow-pits sited at least one chain away from the toe of the bund on the seaward side. To carry the spoil by hand labour from these burrow-pits proved expensive, and a method of sliding it from the burrow-pits down shutes, constructed of planks and supported on frames made from jungle poles cut in the adjacent swamp forest, proved cheap and effective. (See Sketch No. 2, Appendix A). Bunds constructed in this way proved much more stable and maintenance costs dropped considerably.

Construction of Bunds by Drag-line Excavators.

In 1934, it was decided to try re-construction of the coastal bund at Sabak Bernam Peninsula with a dragline excavator. The machine first used was a Priestman ' Tiger,' which had an effective working radius of 50 ft. with a ½ cub. yard scoop. Many initial difficulties were experienced with the use of this machine but the method was proved to be effective and cheap; since then these machines have become the standard equipment for construction of coastal bunds. The dragline excavators now used by the Drainage and Irrigation Department for working in coastal areas are the ⅜ cu. yard scoop (' Wolf ') type with an effective working radius of 26 ft., a boom length of 32 ft. and a gross weight of 10½ tons, and the ⅝ cu. yards scoop (' 19 R.B.') type with an effective working radius of 33 ft., a boom length of 40 ft. and a gross weight of 17½ tons. The machines used are all powered by diesel engines. These machines travel on timber mattresses which they move with them as they travel. The timber mattresses are made of squared, hardwood logs bolted together and provided with handles which make it possible for them to be picked up by the excavator and swung round in front of it to provide a firm track along which it can travel. The general dimensions of the mattresses are as follows:

For the ⅜ cu. yard machine:—

12 ft. long x 30 ins. wide x 5 ins. thick.

For the ⅝ cu. yard machine:—

16 ft. long x 36 ins. wide x 6 ins. thick.

When the machines are travelling over very soft ground it may be necessary to lay the mattresses on logs laid along the line of direction of machine travel. There are generally plenty of logs available from jungle trees felled in the bund reserve.

Particularly since the 1939-45 war, when labourers' wages were increased so much, dragline excavators have proved to be the most economic, reliable and expeditious type of machine for doing this kind of work.

Mobile Belt Conveyor Units.

An experiment is being carried out to increase the effective dumping ranges of dragline excavators by providing a mobile belt conveyor unit which can be pulled along by the excavators as they travel. If proved efficient this may make it feasible to have the burrow-pits excavated as drains on the inside of, and parallel to, the bunds, but at a distance of 1 chain, or further, away from them. It will also be used to spread the spoil obtained from drainage desilting operations without the necessity for cutting down trees to allow the excavator boom to swing through 180°. Spoil dumped on the sides of drains is liable to be washed into the drains by rainfall and is also liable to cause slips of the banks; spreading the spoil by using conveyor units will obviate this.

Burrow Pits.

The inside burrow-pit (drain) has two big advantages in that:

(a) it keeps the ground dry on the inside, at the toe of the bund, where, in its absence, water-logging is liable to occur;

(b) it makes it possible to avoid having burrow-pits on the seaward side of the bunds where burrow-pits are liable to become breeding grounds for malarial mosquitoes and to be eroded by tidal flows.

There are still blocks of land in drainage areas situated near the bunds which are unalienated because of poor drainage facilities. At these places the burrow-pit is sited on the outside of the bund. For some years now the Health Department has reported that burrow-pits situated outside coastal bunds are known to provide condition suitable for the breeding of malarial mosquitoes. This seems to be brought about because it is usually the standard practice to leave stop-offs in these burrow-pits, and these stop-offs create ponds of stagnant, saline water suitable for the breeding habits of *Anopheles sundaicus*. It is usually necessary to leave stop-offs in burrow-pits excavated on the seaward side of coastal bunds because if a continuous burrow-pit is constructed it may become, in time, a wide, deep channel, eroded by the flood and ebb of the tidal water, and result in conditions endangering the safety of the bund. The stop-offs generally consist of banks of ground left unexcavated at regular intervals across the burrow-pits. The intervals vary from 2 chains to 10 chains and are fixed by the tidal range, and so the head of water expected, and by proximity to tidal creeks and drains. The top width of the banks depends also on tidal range, proximity to drains and comparative stiffness of the spoil obtained from the burrow-pits. The top width should not be less than 3 ft.

Type of Spoil and Critical Bund Heights.

The type of spoil available for bund construction in the west coast areas is generally the wet, grey, mangrove mud with no sand admixture. When the spoil dries out after being placed on the bund site it shrinks, and the superimposed load of this spoil usually results in a certain amount of ground settlement occurring. For these reasons it is necessary to dig

a certain percentage of spoil in addition to the nett amount known to be required for the bund section. This extra amount varies from 25 to 150 per cent. of the nett requirement and it is necessary when starting bunding work in any area to make measurements to find out the percentage applicable in the particular case. The stability of the ground on which the bund is to be built should also be tested. There is a critical height above which bund-building is ineffective, and, at places where the critical height approximates to or is below maximum high tide levels, then other sites must be found for the bunds. Tests have been carried out in Sabak Bernam and in Province Wellesley which, in both cases, give the data required for the critical height at the localities, and in both cases resulted in the designed top level of the bund being reduced. Appendix B details the tests carried out in Province Wellesley. If bunds are built to top levels above the critical height, the burrow-pits usually accept spoil back from the bund by movement in the liquid sub-soil, and this movement goes on until the bund has settled down to the critical height.

Siting.

Bunds should be sited far enough away from the coast to ensure that they will not be damaged or breached by sea and wave action. The jungle cover on the land between the coastline and the bund must always be retained, and it is often most convenient to have this coastal strip of land gazetted as a Forest Reserve and administered by the Forest Department. If this is not done, the Collector of Land Revenue should be asked to have a Land Office instruction written on the land revenue sheets for the area to the effect that no land is to be alienated for any purpose (except a public purpose) to the sea-side or outside of the bund. On a non-eroding coastline, the bund should be constructed on a site at least 10 chains inland from the coast. On an eroding coast, the rate of erosion should be measured and the bund sited at such a distance inland as will give it 20 years of use before being attacked by the sea, should encroachment of the sea continue unchecked at the measured rate. In places where land is already alienated for cultivation within close proximity to the sea, it may be economical to protect this land and build the bund on a site where it will be liable to sea-erosion within a limited time and so involve Government in the capital cost of building another bund. The probable revenue accruing to Government from land rents, export duties on produce and drainage rates can be assessed and may prove to be so much in excess of the cost of re-building the bund further inland that its construction there is justifiable. In cases like this, however, drainage control outlet gates should be sited as far inland as outlet channel efficiency makes it practical. Ground levels have sometimes a bearing on the siting of bunds. It is obviously uneconomic to build on ground levels of R.L. 4 when the adjacent ground levels are, say, R.L. 6 and the amount of land between the two contours is small. Finally, the nature of the spoil which can be obtained on the site must be considered, at low levels the ground is sometimes not sufficiently hard to support the excavator or the super-imposed load of the bund.

Land Reserves for Bund Sites.

The ground on which bunds are constructed should be made Government Reserves for that specific purpose. The width of these reserves should be adequate to provide the site for the bunds, berms and burrow-pits and to provide a source from which spoil can be obtained for future maintenance operations. The ground on which the bund is built must first be cleared of trees, tree roots, stumps and other vegetation, as the bund must be built on a solid clay foundation. The berm should be cleared of trees, etc., to ground level and the burrow-pit site must be cleared sufficiently and stumped to allow the excavator to work and to ensure that the spoil used for bund building is free of all vegetable matter, tree roots, etc. Dragline excavators can be used to clear the top soil and smaller tree roots from the burrow-pit site before digging for bund building. It is usually necessary, however, to make a contract for hand-felling, clearing and burning of the tree and scrub cover on the bund, berm and burrow-pit sites and to do complete stumping on the bund site before bund building is started.

Top Widths and Side Slopes.

For the tidal ranges encountered, the type of spoil available and the weather conditions prevalent (heavy, fairly uniform rainfall with no very prolonged droughts) the normal cross-section to which the bunds are built is 6 ft. top width with 2 horizontal to 1 vertical side slopes. Over some stretches of bund, however, where the spoil available has a very high water content, the bund has to be built in two digging operations, the first dug spoil forming, after it dries out, a base for the spoil dug during the second digging. (See Sketch No. 3, Appendix A). Where the bund has to be used as an access route, top widths up to 10 ft. are permissible and, indeed, are desirable as the extra width discourages boring crabs from making holes through the bunds. Bunds with top widths greater than 10 ft. should not be constructed, as the tendency will be to use such bunds for heavy, wheeled traffic which will very soon cause their settlement and lead to overtopping at high tides, with consequent inundation of the land inside, breaches and general deterioration. Roads, in coastal areas, for wheeled traffic should be sited well away from the bunds. At places where it has a high liquid content sufficient spoil should be dumped to allow it to reach the required height without trimming, i.e., the spoil should remain at its natural angle of repose. The only trimming done is to smooth the surface sufficiently to prevent water from collecting in pockets. Double or even triple dumping may be necessary to bring the bund up to the required height.

Trimming and Turfing.

After the bund has been completed, the surfaces are trimmed and planted with grass. At present the trimming is done by hand-labour but it may be possible to modify a tractor-grader so that both the top and side slopes can be trimmed by machinery. The path surface should be formed to a barrelled shape so that it sheds rainwater quickly, and the

side slopes should be trimmed smooth for a distance of at least 3 ft. from the top. The top and side slopes will then be in good shape for periodic grass cutting by mechanical means, and the growth on rest of the bund reserve can be slashed twice a year. Turfing is necessary to prevent erosion by rain, and the following types of grasses and herbs have been found effective:

	Botanical Names.	Malay Names.
(i)	PASPALUM VAGINATUM	Rumput Laut in Krian, Perak. „ Masin in Penang. „ „ „ T. Karang, Selangor.
(ii)	PANICUM REPENS (grass)	Rumput Halia in Penang. „ Laut in Tanjong Karang.
(iii)	ERIOCHLOA ANNULATA (grass)	Rumput Misan in Krian.
(iv)	BRACHIARIA PASPALOIDES (grass)	Rumput Masin in T. Karang.
(v)	RUELLIA TUBEROSA	Pokok Melitit in Krian.

Turfing should be done, if possible, at the beginning of the wet season, when the grass will strike and grow easily. On some spoils a natural growth of grass occurs, on others it is very difficult to get grass to strike. Nevertheless, with perseverance, and if necessary the provision of a thin scattering of good top soil, an adequate turf cover can be obtained in all cases. Planting of turf in horizontal strips is best on clay spoil.

Bund Maintenance.

Maintenance of the bund, which consists of periodic grass cutting and reporting of the presence of crab holes, breaches and other deteriorations, is done by hand-labour on task work and the task work labourers are usually recruited from villages adjacent to the bund. The task work labourer should keep the top of the bund cambered so that it sheds rain water quickly, as thus puddling is avoided as much as possible. He should see that no trees grow up in the reserve which will shade the bund, as puddles, which cause bund slumping and deterioration, quickly develop in the shade of trees. Where the outlet gates which discharge internal drainage water through the bunds are of the screw-down, manually operated type the gate keeper should be provided with a house adjacent to the gate and given a bund maintenance task to keep him fully employed.

In addition to the task-work, maintenance gangs of labourers are employed to do non-routine work on the bunds, such as raising bunds over short stretches where they have slumped or settled below the designed level, digging out and killing the boring crabs, filling up the crab holes, closing breaches, clearing away fallen trees and improving access paths. These gangs work under *mandores* * and are directed by the Drainage

* Mandore = Head man of a gang of labourers.

Overseers. It is desirable that they be housed in Departmental Quarters situated in a central position near the stretch of bund they work on, so that they may be easily available in an emergency.

Summary.

(i) The bunds should normally be sited at least 10 chains inland from the coast on a non-eroding coast, and further inland on an eroding coast.

(ii) The land between the coast and the bund should be kept under jungle and alienation should be prohibited.

(iii) If the burrow-pit is excavated on the inside of the bund, a berm *at least one chain in width* should be retained between the toe of the bund and the edge of the burrow-pit.

(iv) If the burrow-pit is excavated on the outside of the bund, a berm *at least ¾ chain in width* should be retained between the toe of the bund and the edge of the burrow-pit, and stop-offs should be left in the burrow-pit, where required, to prevent erosion by tidal ebb and flow.

(v) The internal drainage should be adequate to keep the land dry on the inside of, and adjacent to, the bund.

(vi) Within the limit imposed by the tidal range, the critical bund height should be decided by making loading tests and building trial sections.

(vii) The percentage of spoil required in addition to net designed requirements must be decided from the data obtained from the tests and trial sections.

(viii) Grass should be planted on the bund as soon as it is trimmed.

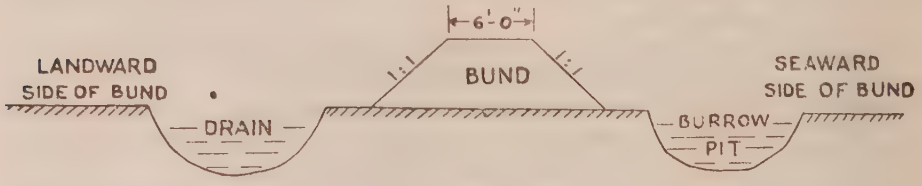
Appendix A.

Construction of Coastal Bunds.

Sketch 1.

DRAIN AND BURROW PIT CLOSE TO BUND

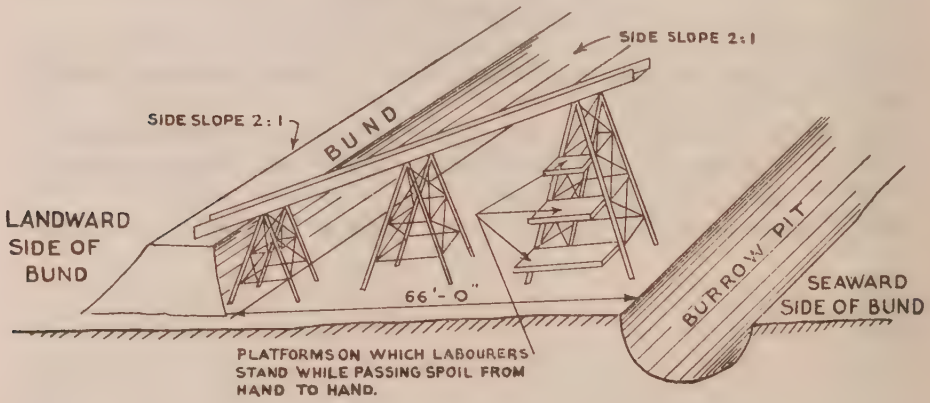
(See paragraph 2)



Sketch 2.

HAND-DIGGING SPOIL AND PLACING BY USE OF SHUTES

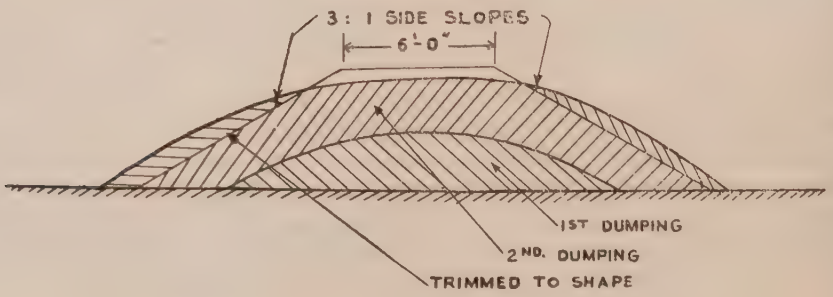
(See paragraph 2)



Sketch 3.

DOUBLE DIGGING OF SPOIL WITH HIGH WATER CONTENT

(See paragraph 8)



Appendix 'B'

Critical Heights for Coastal Bunds.

When the Sabak Bernam Peninsula Bund was designed in 1932, the top of the bund was shown at R.L. 11, while ground levels were between R.L. 4 and R.L. 6. The contractor who was building the bund, using a drag-line excavator, was, under the terms of the contract, obliged to hand over the bund in three stretches, each five miles long. At the start of the work the excavator dug a burrow-pit of 125 sq. ft. section to build a bund of 90 sq. ft. section to a height of R.L. 11, later and by stages more and more spoil was dug to get sufficient to allow for settlement until finally the burrow-pit section was increased to 220 sq. ft. In spite of digging all this excess spoil it was found that by the time five miles of bund had been completed, the part first constructed had sunk to below R.L. 10. Using hand labour to dig more spoil, the contractor raised the top of the bund at the beginning of the first five miles stretch to R.L. 11, only to find that the most recently completed part of the stretch had, by this time, sunk below R.L. 10. This was then raised by hand labour and the unfortunate contractor found that the part first completed had again sunk below R.L. 10. After expenditure of a considerable sum of money for employment of hand labour to retain the bund to R.L. 11, loading tests were carried out to ascertain what safe load the ground on which the bund was being built could carry. All records of these loading tests have unfortunately been lost. They were carried out by loading a wooden platform with pig iron and recording the settlement occurring under various loads. The tests indicated that the critical height for the bund was R.L. 9.5 and that a bund built to this height was reasonably stable, but if built above R.L. 9.5 it very soon sank to that height. High water at spring tides is R.L. 7.5. The contract was then amended and the contractor was allowed to hand the bund over in five miles stretches provided the height was R.L. 9.5 or over. No further trouble was experienced.

More recently, trouble has been experienced with a bund constructed at Bukit Tambun in Province Wellesley. Part of this bund had, on account of certain extraneous circumstances, to be sited on a narrow piece of ground between the sea and a deep drain running parallel with it on the inside. Serious settlement occurred after the bund was built and trimmed, and experiments were carried out to find the critical height to which this bund could be maintained. First of all a tank made of concrete pipes, sealed at the bottom, was set up at ground level; this tank was filled with water to a depth sufficient to give a load equivalent to a bund of a certain height. Levelling was done to find out what settlement occurred and the depth of water level inside the tank was varied to give data on the settlement resulting from the loads imposed by bunds of various heights. Unfortunately the tank was sited very close to the burrow-pit and the movements observed were partly attributable to this proximity. Nevertheless, this method of imposing various loads is a con-

venient one and is recommended for use as a method of making load tests.

Next, three trial sections of the bund, each 100 ft. long, were built up by hand and trimmed to the required sections with top heights of R.L. 7.5, R.L. 7.00, R.L. 6.5. Levelling of these sections was done periodically but so far the levels obtained give inconclusive data, the indications are, however, that the critical height is between R.L. 6.5 and R.L. 7.00 and that three months after dumping spoil and building a bund to R.L. 7.5 the same final result as dumping less spoil and building to R.L. 7.00 is obtained. In the meantime, pending more data being made available, the Drainage and Irrigation Engineer is trimming the bund to R.L. 7.00, in anticipation of final settlement to R.L. 6.5. This is adequate, as the high tide levels during the equinoxes do not exceed R.L. 4.7. When experimental stretches are trimmed to various heights, level surveys should be done immediately on completion of trimming, again three days later, again ten days later and thereafter at intervals of one month, until the final settlement is reached. The cross-sections should be extended to include levels of adjacent burrow-pit and/or drain so that records of 'creep' can be obtained.

The method of obtaining an estimate of the safe bearing pressure on the ground, by recording the movement of test loads, does not take into account variations resulting from loss of the water content of the spoil, and the information given by this type of test, while it will help to indicate the critical height to which the bund should be built, will not give data on the extra spoil required to make good losses due to consolidation and contraction on drying out. The method of testing by building experimental sections, trimmed to various heights, does give figures which can be used for calculating a critical bund height (which can be checked with the results obtained from test loads) and also gives figures which can be used to estimate the excess digging from the burrow-pit required in addition to the net bund yardage.

PADI MANURIAL AND CULTURAL TRIALS IN THE 1949—50 SEASON

BY

E. F. ALLEN,

Acting Senior Agricultural Officer (Research).

Introduction.

Birkinshaw (1940 and 1941) has reviewed the background of agronomic investigations on padi and Wilshaw (1936, 1937 and 1939) has described in some detail the results obtained from pre-war agronomic investigations other than variety trials. The purpose of this report is to give a concise summary of agronomic investigations, again excluding variety trials, carried out throughout the Federation in the 1949-1950 season.

Since experience has shown that results from wet padi investigations are not applicable to dry padi, trials on the two crops will be dealt with in separate sections.

Wet Padi Manurial Trials.

There were seven series as follows:—

(1) North African versus Christmas Island Rock Phosphate.
(2) C.I. Rock Phosphate versus guano and " Chelop."
(3) Phosphate Placement Trials using N.A. Rock Phosphate.
(4) Time of application.
(5) " Chelop " trials.
(6) Guano trials.
(7) Off-season cropping and manures.

North African versus Christmas Island Rock Phosphate.

This experiment, which was carried out in eight localities, tested the following treatments:—

A. Control—No manure.
B. N.A. Rock Phosphate @ 100 lbs. P_2O_5 per acre.
C. „ „ „ 200 lbs. „ „
D. C.I. „ „ 100 lbs. „ „
E. „ „ „ 200 lbs. „ „

One of the experiments, at Parit in Perak, was very severely damaged by *Scotinophara coarctata* and was finally abandoned in December, 1949.

Yields from the other experiments are summarised in Table I.

Table I.

Yields of Grain expressed as per cent. of Control.

Experiment No.	A Control	B N.A.R.P. Single	C N.A.R.P. Double	D C.I.R.P. Single	E C.I.R.P. Double
K.P. 15	100	97	102	101	102
PK.C. 3/49	100	112	107	100	98
PK.N. 6/49	100	123	109	84	87
PK.S. 8/49	100	101	110	81	92
Kn. 30	100	107	109	103	107
M. 14	100	104	111	105	101
BM. 11	100	113	121	135	108

In no case were differences statistically significant, therefore no conclusions may be drawn from these results.

The large differences in trials BM. 11 and PK.N. 6/49 were associated with very high experimental errors due to severe *penyakit merah* (a physiological disease) and sea-water flooding respectively.

The experiments are being repeated in the 1950-51 season.

Christmas Island Rock Phosphate versus Guano and Chelop.

There were three Perak experiments in this series on small-holders' land and the treatments were:—

A. Control—No manure.
B. Rock Phosphate at 200 lbs. P_2O_5 per acre.
C. "Chelop" with calcined bones.
D. Bat guano at 100 lbs. P_2O_5 per acre.
E. Rock Phosphate at 100 lbs. P_2O_5 per acre.

The *Chelop* treatment consisted of the time-honoured Malay method of making a thick slurry of calcined bones, mud and water and first dipping the seedling roots in this before transplanting into the field.

The results from one experiment were unsatisfactory owing to neglect of the area by the small-holder. Results from the other two trials are summarised in Table II.

Table II.

Yield of Grain as percentage of Control.

Experiment No.	A Control	B R.P.— double	C *Chelop*	D Guano	E R.P.— single
Pk.S. 6/49	100	106	108	86	102
„ 7/49	100	180	174	171	201

Block variance was very high in the first trial and differences were insignificant. In trial Pk.S. 7/49 treatments B, C, D and E were all superior to control and the differences were statistically significant at 1 per cent. There were no other significant differences. These two trials were situated on upland, well-drained soils where it was thought, on theoretical grounds, that phosphate would give a marked response. Unfortunately these important trials are not being repeated in the current season. It is interesting to note that the comparatively small application of phosphate by the *chelop* method to the padi roots was as successful as mixing a much larger dressing with the soil just before transplanting.

Phosphate Placement Trials.

There were four placement trials in this series and the treatments were:—

A. N.A. Rock Phosphate broadcast at 200 lbs. P_2O_5 per acre before transplanting.
B. Same application placed in a furrow between rows.
C. Same application placed in an individual pocket round each plant.
D. Control—No manure.

One experiment was a complete failure owing to salt-water flooding. Yields from the other three trials are given in Table III.

Table III.

Experiment No.	A Broadcast	B Furrow	C Groove	D Control
K/P. 16	96	98	97	100
Kn. 31	95	88	97	100
M. 15	129	114	110	100

No differences approached the 5 per cent. level of significance and no conclusions are justified. Differences in the M. 15 trial were significant at the 10 per cent. level. These trials are being repeated in the 1950-51 season.

Time of Application.

There was only one experiment in this series (Kn. 34) and it proved to be the most important padi manurial trial of the season. The treatments were:—

A. Mono-ammonium phosphate applied 1 to 2 weeks after transplanting.
B. Mono-ammonium phosphate applied 6 weeks after transplanting.
C. Mono-ammonium phosphate applied 10 weeks after transplanting.
D. Control—No manure.

The application rate was equivalent to 300 lbs. per acre and the fertilizer was applied to each plant individually by inserting a measure beneath each clump 3 ins. below the soil surface.

Yield of grain expressed as a percentage of control is given in Table IV.

Table IV.

Yield Grain	A	B	C	D	Mean	S.E.
Yield as percentage of Control	121	151	149	100	130	3.215
Yield in lbs. per acre	2,754	3,438	3,402	2,227	2,968	73.20

It will be seen that a fertilizer application six or ten weeks after transplanting gave an increased yield (significant at 1 per cent.) over the same application 1 to 2 weeks after transplanting and over control. The yield from the earliest application was greater (significant at 5 per cent.) than from control plots.

Yields of straw were somewhat different as treatment B yielded most, D least and A and C about the same quantity.

It will be noted that a dressing of 300 lbs. per acre of a soluble fertilizer applied 6 to 10 weeks after transplanting gave a 50 per cent. increase in crop or the equivalent of about 1,193 lbs. per acre of grain.

Plant tissue analysis revealed the following quantities of nitrogen and phosphate, expressed as proportions of the amounts supplied in the fertilizer dressing:—

Treatment		Nitrogen	Phosphate (as P_2O_5)
		per cent.	per cent.
A	....	127	8.3
B	....	151	8.5
C	....	142	5.7

The comparatively low intake of phosphate suggests that the nitrogen in the fertilizer probably contributed more to the yield increase.

Chelop Trials.

There were four experiments in this series testing the following different fertilizers as a slurry applied (*menchelop*) to the roots before transplanting:—

Experiment	Fertilizer
K/P. 25	North African Rock Phosphate at 13½ lbs. P_2O_5 per acre.
	Christmas Island Rock Phosphate at 13½ lbs. P_2O_5 per acre.
M. 7, 8 and 9	Calcined bones
	Cowdung.

Yields of grain from these trials are given in Table V expressed as percentage of control.

Table V.

Experiment No.	N.A. Rock Phosphate	C.I. Rock Phosphate	Control
K/P. 25	108	107	100
	Calcined Bones	Cowdung	Control
M. 7	109	102	100
M. 8	122	96	100
M. 9	116	107	100

None of the differences approached significance and experimental errors in the Malacca experiments were very high.

Guano Trials.

There are two long-term trials in this series which are being carried out at Bukit Merah (P.W.) and Teluk Chengai (Kedah).

The B.M. 5 trial was laid down in 1947 with the following treatments:—

Main Treatments		Sub-Treatments	
A. Annual application guano.			(a) 3,000 lbs. Guano per acre.
B. Applied every 2 years.	first application 1947.		(b) 4,500 - do. -
C. „ „ 3 „			(c) 6,000 - do. -
D. „ „ 4 „			(d) 7,500 - do. -
E. „ „ 5 „			(e) 9,000 - do. -
			(o) Control—no manure.

Yields of grain in the 1949-50 season are given in Table VI.

Table VI.

A	B	C	D	E	Mean
96	102	98	100	105	100

a	b	c	d	e	o
107	114	122	125	129	100

" A " plots have received the sub-treatment dressings three times and " B " plots twice (in 1947 and 1949). However, in spite of the fact that " C," "D" and "E" have all been treated the same to date yet "E" plots have yielded significantly higher than other treatments. Treatment

B was naturally superior to treatment C and unexpectedly superior to A. Similarly the significant superiority of D over A cannot easily be explained. All differences between sub-treatment dressings were significant, indicating a marked response in yield to Bat Guano applications. The increments for increased dressings were smaller over the 4,500 lbs. per acre level.

The interpretation of the significant interactions between main and sub-treatments is extremely difficult. Thus the 3,000 lbs. per acre dressing gave a response in the B, D and E plots but not in the A and C plots. The reason for this is obscure because as noted already, C, D and E plots received identical treatment up to the 1950 harvest.

In the Kedah Trial (K.P. 2) Treatments were the same as in Bukit Merah but sub-treatment (a) was omitted.

Yields of grain are given in Table VII.

Table VII.

A	B	C	D	Mean
101	102	98	98	100
4,500 lbs.	6,000 lbs.	7,500 lbs.	9,000 lbs.	Control
102	99	101	102	100

The small differences between main and sub-treatments were not statistically significant.

Off-Season Cropping and Manures.

Only one experiment, BM 1, was designed to test the following treatment:—

A. Control—no off-season crop, no manure.
B. No off-season crop—fallow manured.
C. Off-season sweet potato, unmanured.
D. Off-season sweet potato, manured.
E. Off-season groundnuts, limed.

The padi crop yielded at the rate of only 174 lbs. per acre owing to severe *penyakit merah* and experimental yields have not been analysed. The value of this trial as a long-term investigation has been reduced by alterations to the layout and treatments.

Sowing Method Trials.

Preliminary observation trials on seeding methods were carried out in 1949 and these were followed up by five trials of the following methods:

A. Dry seeds.
B. Seeds soaked for 24 hours.
C. Seeds soaked for 24 hours and kept for 24 hours.
D. Seeds soaked for 48 hours and kept for 48 hours.

Each type of seed was broadcast.

M. on wet mud and

W. into 2 ins. water.

A replicated trial at Serdang (FESS 48) indicated that dry seeds were inferior to soaked seeds in the number of germinated plants but no other differences were significant. On the other hand the same trial in Lower Perak (Pk.S. 11/49) indicated that sowing on wet peat gave a greater stand of plants than sowing on flooded land. Subsequently other factors came into operation, growth was stunted and no crop was obtained.

Observations elsewhere (M. 16 and Kn. 36) confirmed that dry seed was inferior but differences between mud and water were inconsistent.

At a fourth locality (BM. 8) no apparent differences at all were observed.

Wet Padi Cultivation Trials.

Time and Depth Series.

In this series, the following treatments were tested:—

A. Deep ploughing, early.
B. „ „ normal time.
C. „ „ late.
D. Shallow ploughing, early.
E. „ „ normal time.
F. „ „ late.

(A–F: Tractor ploughing —deep about 8 ins. —shallow 4 ins.)

G. Buffalo shallow ploughing, normal time.

Actual deep ploughing varied from 5 to 8 ins. according to locality and type of plough.

This experiment was carried out in four localities and yields of grain expressed as percentage of control (G) are given in Table VIII.

Table VIII.

Experiment No.	A	B	C	D	E	F	G
M. 17	89	70	116	111	114	109	100
B.M. 9	98	99	96	107	103	94	100
Kn. 12	102	103	116	93	105	46	100
Kn. 19	68	103	61	84	61	77	100

The trial M. 17 was replicated three times, the two Kelantan trials twice and the Bukit Merah one was unreplicated. All differences were non-significant. At Pulau Gadong (M. 17) it was noted that treatment D (shallow cultivation after harvest) gave the densest weed growth and treatment G (Cultivator's method) gave the least.

Depth and Off-Season Series.

There were two experiments in this series—Kn 13 and M. 18.

The main treatments tested were;

A. Deep ploughing (8 to 10 ins.) after harvest.
B. Shallow ploughing (4 ins.) after harvest.

In addition the following sub-treatments were superimposed:—

1. Off-season crop.
2. Bare fallow, kept cultivated.
3. Green manure crop.
4. Natural weed growth.

Yields are given in Table IX.

Table XI.

Experiment	A	B	Mean
Kn. 13	100	100	100
M. 18	100	100	100

Experiment	1	2	3	4	Mean
Kn. 13	103	119	87	91	100
M. 18	98	100	100	102	100

Differences in the Malacca experiment were insignificant but in Kelantan, bare fallowing gave significantly (at 1 per cent.) higher yields than cropping with a green manure or leaving the natural off-season growth. A marked significant interaction confirmed that this superiority was only noted in the shallow-ploughed plots.

Interpretation of this result is difficult. If the same trend is noted next season an explanation should be sought by soil examination.

Depth and Double Cropping Series.

Experiment B.M. 7 tested the effect on yield of padi of two depths of cultivation with and without double-cropping. Actual treatments were as follows:—

	Main Padi Season.	Off-season.
A.	Buffalo cultivation (control)	No crop, no cultivation.
B.	Deep (8 ins.) ploughing.	Deep ploughing for off-season padi.
C.	Shallow (4½ ins.) ploughing.	Shallow ploughing for off-season padi.

Padi yields from the 1949-50 main season crop are given in Table X.

Table X.

B.M. 7	A	B	C
Yield as percentage of Control	100	83	122

There were only two replications, error being high and differences non-significant. It was observed that deep ploughing reduced weediness as compared with shallow or buffalo ploughing.

Horticultural Machinery Series.

Different methods of padi land cultivation by horticultural machines were tested in trial Kn. 22 against cultivation by the Kelantan plough and harrow as control. Actual machines used in the treatments were as follows:—

Kelantan buffalo-plough and harrow.
B.M.B. " Plowmate " and associated equipment.
" Gem " rotary hoe.
" Trusty " tractor and associated equipment.

No differences were noted after two seasons work and the experiment has now been discontinued. Nevertheless the experiment has proved a useful working test of the different machines and, as a result, the Trusty tractor is now used for small ploughing jobs " in the wet " whereas the B.M.B., with its locally made roller, is a handy combination for after cultivation. It should be noted, however, that the operation of these small machines is relatively expensive and it is almost certain that a small four-wheeled tractor can do similar work better and more economically.

Dry versus Wet Series.

Dry versus wet mechanical cultivation has been tested in trials Kn. 28 and M. 19 with the following treatments:—

A. Dry cultivation and seed dibbled or drilled in the dry.
B. Dry cultivation followed by flooding and subsequent transplanting.
C. Wet cultivation followed by normal transplanting.

Yields from the 1949-50 harvest are summarised in Table XI.

Table XI.

	A	B	C	Mean
Kn. 28	77	84	140	100
M. 19	79	113	108	100

Differences were not significant in the M. 19 trial but, in Kelantan, " C " was significantly superior to the other treatments at 1 per cent. It was noted that dibbling in treatment A gave a poor stand but the superiority of C over B is difficult to explain. The S.A.O., Kelantan, has wisely remarked that comment is best deferred until after next harvest.

Pahang Series.

In a Pahang series of cultivation experiments the following treatments were tested:—

A. Tajak—normal slashing by local scythe.
B. Lanyak—buffalo puddling.

C. Changkol—digging by hoe (Parang slashing in S. Phg. 1).
D. Plough and harrow (Rangai * in S. Phg. 1).

Yields of padi are given in Table XII.

Table XII.

	A	B	C	D	Mean	Mean yield in lbs./acre.
Raub 1 -	96	102	102	101	100	3,513
S.Phg. 1 -	100	97	102	102	100	1,841
E.Phg. 3 -	109	90	99	102	100	2,014
E.Phg. 5 -	95	105	100	101	100	85

Experimental errors were high in all four experiments and no differences approached statistical significance.

Age of Seedling Trials.

There were four experiments under this head wherein the optimum age of seedlings for transplanting was investigated. Treatments in the three Kedah trials were:

A. Seedlings transplanted when 30 days old.
B. „ „ „ 45 „ „
C. „ „ „ 60 „ „
D. „ „ „ 75 „ „

Mean yields are given in Table XIII and it will be seen that the optimum age of seedlings varies with maturation period.

Table XIII.

Experiment	Variety	Maturation	A	B	C	D	Mean
K/P 3A	Haji Harun	Short	141	101	82	75	100
K/P 3B	R.C. 4	Medium	117	111	97	76	100
K/P 3C	SK. 48	Long	107	109	100	85	100

It will be seen that the youngest seedlings yielded best in the short-term variety and that, with longer maturation periods, an older seedling was equally good or somewhat better.

At Bukit Merah, where a very short-time Taiwan variety was grown, seedlings were transplanted at 25, 35, and 40 days old.

Yields expressed as percentages of the Mean are given in Table XIV.

Table XIV.

Experiment	25 days	35 days	40 days	Mean
B.M.O. 4	152	90	58	100

* Merangai = To pull up weeds by hand.

Differences were significant, the youngest seedlings showing better tillering and growth and highest yields.

DRY PADI INVESTIGATIONS

Introduction.

Five experiments were carried out at Melor Agricultural Station, Kelantan, in continuation of pre-war agronomic investigations which were re-commenced in 1948 (Ashby 1949). There was one manurial trial (Kn. 33), one seeding trial (Kn. 21) and three cultivation trials (Kn. 14, 15 and 18). The manurial trial was in its first year but the other four experiments were repeats of the previous season's investigations.

Manurial Trial.

In trial Kn. 33, the following treatments were tested:—

A. Ploughed and disc-harrowed—no manure (Control).
B. 3 cwt. per acre mono-ammonium phosphate ploughed in, then harrowed.
C. 1½ cwt. per acre mono-ammonium phosphate ploughed in, then a second 1½ cwt. broadcast and then harrowed in.
D. 3 cwt. mono-ammonium phosphate broadcast after ploughing, then harrowed in.

Yields expressed as percentages of control are given in Table XV.

Table XV.

Kn. 33	A	B	C	D	Mean in lbs. per acre
Straw -	100	172	168	147	4,900
Grain -	100	155	149	153	1,526

Unfortunately there were only two replications and these big differences failed to attain significance at the 5 per cent point. However, the trend is obvious and the results have been used in the planning of a properly replicated experiment (Kn. 39) in the current season.

Seeding Trial.

In Trial Kn. 21 the following treatments were tested:—

A. Mitchell—drilled at 21 ins. spacing and 25 lbs. per acre.
B. Mitchell—drilled at 7 ins. spacing and 37 lbs. per acre.
C. Control-seed dibbled in at 25 lbs. per acre.
D. Mitchell—drilled at 14 ins. spacing and 29 lbs. per acre.
E. Mitchell—drilled at 7 ins. spacing and 32 lbs. per acre.
F. Mitchell—drilled at 14 ins. spacing and 30 lbs. per acre.
G. Mitchell—drilled at 21 ins. spacing and 14 lbs. per acre.
H. Trusty—drilled at 12 ins. spacing and 50 lbs. per acre.

Yields of grain expressed as percentages of control are given in Table XVI.

Table XVI.

A	B	C	D	E	F	G	H
84	92	100	85	101	89	74	83

In spite of the fact that there were four replications in this experiment, allowing 21 degrees of freedom for error, the experimental error was so high that the large apparent differences did not approach significance. No conclusions are therefore justified.

Cultivation Trials.

Kn. 14 was a "Depth and Time" trial with the following treatments:—

1. Deep ploughing, early (after harvest).
2. Shallow ploughing, early (after harvest).
3. Deep ploughing, normal time.
4. Shallow ploughing, normal time.
5. Deep ploughing, late.
6. Shallow ploughing, late.
7. Control—Animal ploughing and harrowing, normal time.

The early ploughing was carried out in February-March, the normal ploughing in April-May and the late ploughing in May-June. Depths of ploughing were 8 to 10 ins. and 4 ins. for the deep and shallow treatments respectively. Mean yields expressed as percentages of the control are given in Table XVII.

Table XVII.

1	2	3	4	5	6	7
109	107	147	101	163	85	100

Deep ploughing, both late (5) and at the normal time (3), gave significantly higher yields of grain than all other treatments. There were no other significant differences.

Kn. 15 was a "Depth and Off-season" trial with the following treatments:—

A. Deep ploughing after harvest.
B. Shallow ploughing after harvest.

Plots were split for four sub-treatments:—

P. Natural cover allowed to grow.
Q. Green manure grown and later ploughed in.
R. Bare fallow kept cultivated.
S. Short bare fallow fallowed by off-season crop of groundnuts.

Yields of grain expressed as percentages of the general mean are given in Table XVIII.

Table XVIII.

	P	Q	R	S	Mean
A	102	119	97	131	112
B	91	79	88	94	88
Mean	96	99	93	112	100

Deep ploughing was significantly superior to shallow ploughing at 1 per cent.) Furthermore, an off-season crop grown with some manure results in a higher padi yield (significant at 5 per cent.) than digging in a green manure crop grown without fertilizer. Off-season cropping is also superior to allowing the normal off-season weeds to grow or to bare fallowing.

The significant interaction between ploughing and cropping indicates that the superiority of deep ploughing was most marked when accompanied by off-season cropping or by green manuring.

Four different methods of cultivation were tested in trial Kn. 18:—

A. "Trusty" ploughing and cultivation.
B. "Gem" rotary hoeing.
C. "B.M.B." ploughing and cultivation.
D. Kelantan animal-plough and harrow.

Mean yields from these treatments are given in Table XIX.

Table XIX.

A	B	C	D	Mean
132	79	105	85	100

Differences just failed to attain significance at the 5 per cent. point. This experiment has been discontinued because the small horticultural machines under trial have been found to compare unfavourably both in cost and efficiency with four-wheeled tractors.

Discussion.

It is notable that in a series of twenty wet padi manurial experiments significant responses to fertilizers were obtained in only three trials. One of these was at Kota Bharu, in Kelantan, where excellent responses to manures have been obtained before (Wilshaw 1939). The second site was on a small-holding near Tanjong Malim, in Perak, where both drainage and irrigation control was excellent. The third site was at Bukit Merah in Province Wellesley, where very heavy dressings of Bat Guano gave comparatively small yield increases.

The failure of wet padi alluvial soils on the western side of the Peninsula to give a reasonable response to manuring has already been

remarked on both by Belgrave (1934) and Wilshaw (1939). It may be that this failure is due to incorrect placement of these fertilizers or to use of the wrong type of fertilizer or to some other factor, such as inadequate aeration of the soil water or accumulation of plant toxins in the soil. It is imperative that this problem be solved and, with this aim in view, a much larger series of manurial trials is being carried out in the current season and a still more ambitious programme has been planned for the 1951-52 season.

One clear fact that has emerged from cultivation experiments on wet padi is that experimental error in such trials is invariably high and this usually masks any differences which may be caused by experimental treatments. Partly for this reason, and also because of the extended manurial trial programme, these investigations are being partially curtailed. In new field trials, every endeavour will be made to increase the number of replicates and to widen differences between treatments.

The marked benefit of deep cultivation on dry padi land confirms a result reported for the previous season (Ashby 1949). These experiments are being continued in the current season and results will be used to plan a more elaborate programme for the 1951-52 season.

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NOTES ON THE CONTROL OF TREES AND WEEDS BY PHYTOCIDES

BY

T. A. BUCKLEY,

Ag. Chief Research Officer.

A request was received from the Colonial Office for information as it affects Malaya on the species of weed and tree growth which it may be desired to control or eradicate, and the relations of such species to crops. The information was needed for an enquiry into the applicability of modern herbicides, arboricides and defoliants to crop production problems in Colonial Territories generally.

It appeared that the information when compiled would be of general interest, and the notes which follow are substantially the same as were submitted to the Colonial Office.

There is a demand for phytocides in Malaya for the following purposes:—

1. Destruction of trees.
   (a) Forest or secondary forest.
   (b) Old tree crops.
2. Destruction of weeds.
   (a) On dry land.
   (b) In padi fields and water courses.

The destruction of trees in forests may be desired either for forest improvement or for agricultural development. In the former case, unwanted species which it is not economic to extract for any purpose are poisoned by sodium arsenite after frill girdling, and by this means space becomes available for the wanted species. As a preparation for agriculture, the incentives for the use of arboricides are reduction in cost of opening up, and soil conservation. The old method of felling and burning was expensive and in its violent disturbance of the pre-existing equilibrium caused a loss of fertility, which loss was greatly accentuated if burning was followed by stumping and clean clearing. If the trees are poisoned, the undergrowth slashed, and cleared on parallel strips for planting, the crop such as rubber eventually replaces the forest with the minimum of soil disturbance and exposure. Difficulties experienced are that large buttressed forest trees require no little effort to reach and to prepare for poisoning, and that sodium arsenite may be ineffective or may only partially kill the tree. There is therefore a need for a more effective arboricide than sodium arsenite.

The destruction by poison of old stands of rubber in preparation for replanting with improved material is a widespread practice. In this case sodium arsenite is very effective and rubber trees are very uniformly killed, but nevertheless, other poisons are being investigated by the Rubber Research Institute as possible substitutes for sodium arsenite. The

falling of dead branches and trunks in due course inflicts a certain amount of damage on the young rubber trees. Another disadvantage, consequent on non-disturbance of the soil, is that fungus root diseases are not checked and that the young rubber trees may be extending their roots into infected areas. A phytocide which would poison a rubber tree and also poison the fungi attacking its roots would be a most desirable development. Replanting of oil palms has not yet become widely necessary, but it has been found that insertion of solid sodium arsenite in a single auger hole in the oil palm stem quickly kills the palm, and the method has been adopted.

Of the weeds with which Malaya is afflicted, the grass "lalang" (*Imperata cylindrica*) is pre-eminent; it is the enemy of every occupier of land. This pest spreads rapidly by wind-borne seed and penetration of its stolons. It is suppressed by dense shade and by frequent regular mowing, but in the absence of control rapidly colonises open spaces and can often take complete possession. It is particularly susceptible to fire by chance ignition, but after fire lalang springs up again as though invigorated, benefiting by the destruction of its competitors. Another pest frequently associated with lalang is the woody "sendudok," *Melastoma malabathricum* Linn., which has a capacity for surviving fire to a small extent. It appears on untended land with great rapidity and grows into bushes. The sensitive plant, *Mimosa pudica* Linn., is a pest of all kinds of grassland, especially where the herbage is grazed or not closely mowed. Even regular close mowing does not eradicate it as it can survive with an extremely low habit. It has long fleshy roots and survives drought, so that it often thrives in poor or stony dry conditions, and is an early colonist of areas of newly exposed subsoil where grasses cannot establish themselves on such a surface frequently baked by the sun. A common pest which grows to a considerable height, spreads rapidly and makes a smothering cover is the fern "resam," *Gleichenia linearis*. It is mostly found on the fringes of secondary forest, in clearings, and among tree crops. A persistent pest of orchards and garden cultivation is nut-grass, *Cyperus rotundus* Linn., which is usually checked only by smothering with a crop.

Eupatorium odoratum Linn. is becoming increasingly prevalent, but this like *Fagraea racemosa* Jack and many other weeds, as well as bracken and various ferns, are not to be regarded as important pests. Their control in rubber, oil palm, and coconut plantations is nevertheless a source of expense. Instead of the usual practice of slashing many planters prefer to use sodium arsenite spraying as being more economical and effective.

Lalang was eradicated in the past by a laborious and expensive process of digging out, and collecting and destroying the underground runners on which the outstanding vitality of the plant depends. Those who have tractors and implements can do the work more quickly and cheaply. In dry weather, disc-harrowing followed a few days afterwards by rooting exposes the roots to the sun and they die out, so that afterwards but little hand labour suffices to eradicate the sporadic regrowth. This

process has a serious fault in exposing the soil to sun and wash, as well as not being always applicable amongst tree crops, and planters have eagerly taken up sodium arsenite spraying for general lalang destruction. A light application of sodium arsenite in solution (10 lbs. per acre) kills the lalang above the ground, but a new growth soon springs up again, and as many as ten sprayings are required before it is finally killed. The use of a spreader such as Teepol in the arsenite solution increases the efficiency of the spray. Sodium chlorate can be used in the same way as sodium arsenite, but it is less effective and more expensive. Lalang has proved to be totally resistant to all forms of 2-4D, or other growth control hormones tested. Herbicides such as dinitro-o-cresol and pentachlorphenol have been unsatisfactory, as well as various mineral oil fractions. One such mineral oil fraction, "Sovacide," produced by the Standard Oil Company, tried recently, is showing considerable promise. This oil may be sprayed directly, or for reasons of economy it may be diluted with Diesel fuel, but to cheapen the treatment sufficiently for general use it is necessary to use water as the diluent. Tests are still being made to find the most economical agent to emulsify the oil in water, but so long as this oil can be kept in an adequate state of dispersion in water it is effective, and four rounds of spraying have been found to suffice to destroy lalang as compared with ten rounds with sodium arsenite. The total cost is much the same, but time is saved and the inconvenience of the statutory precautions governing the use of sodium arsenite is avoided. Herbicides about to be tried in the Department are sodium trichloracetate (T.C.A.) and dinitro-o-sec-butylphenol. The Rubber Research Institute has already found T.C.A. to be effective, but at very high cost. The Institute has also been investigating 2-4-5 T and ammate (ammonium sulphamate).

A cheap and effective means of killing lalang is an objective of first importance, and it must apparently be something to which the stolons and roots are vulnerable. Lalang is a source of untold loss and inconvenience to the community. It obstructs re-afforestation by suppressing seedlings, and the fires which so easily run through it tend to destroy tree growths which have succeeded in rising above it. It similarly affects plantations and its roots are said to be harmful to cultivated plants and trees. Its roots tend to choke subsoil drains provided for anti-malarial work, and valleys having anti-malarial drains have to be regularly mowed to suppress lalang. Lalang-covered areas also provide the conditions which are specially suitable for harbouring trombiculid mites which transmit scrub typhus. It is when working amidst lalang that there is most danger of persons contracting that disease.

Melastoma is usually destroyed by slashing. It is incidentally poisoned by sodium arsenite. With 2-4D ester, even by three sprayings at monthly intervals, it is only defoliated. In grazing grounds young lalang is eaten by cattle and therefore that pest is suppressed, but *Melastoma* is not touched and becomes a nuisance. Mowing as well as grazing is necessary to keep a pasture in good condition. Melastoma has a virtue

that it assists in regeneration of secondary tree growth on bare soil, or amongst lalang if fire is avoided.

Mimosa pudica thrives on grazing grounds or other grassland. It is not usually touched by stock except goats, and is so low as to escape destruction by mowing. Trials have been made in suppressing it with 2-4D, in which there was some partial success but such treatment is not economic. The most successful treatment in pasture is to tear the *Mimosa* out mechanically at intervals.

Gleichenia may become very dense and obstructive, as it climbs high above its own dead growth. It is controlled by slashing, and easily succumbs to sodium arsenite spraying. Burning destroys it completely.

Nut-grass is a most troublesome pest unless it can be suppressed by taller growth. Digging out, which can deal with lalang, is virtually futile with nut-grass on account of its multitude of nuts or tubers which escape observation. Various forms of 2-4D, especially the sodium salt, destroy the growth above ground, but new growth quickly sprouts and repeated treatments do not kill the pest outright. The effect of hormone spraying may in fact be the reverse of what is intended, for the nut-grass benefits by the destruction of other species growing amongst it.

The conditions in which padi is grown, namely submergence of the fields in several inches of water, protect the crop from the competition of dry land weeds, but there are numerous semi-aquatic weeds which have to be controlled by the cultivator. In the off-season fallow a profusion of weeds develops in the padi fields, and the first objective at the start of the planting season is by digging or ploughing to invert the sod and to flood and puddle the soil. The transplanted padi normally grows well ahead of a new growth of weeds, but two weeding rounds are required during the season to give the padi proper protection from competition. Among the principal species of weeds which affect padi fields are:—

Jussiaea suffruticosa	....	....	Linn.
„ *linifolia*	....	....	Vahl.
„ *repens*	....	....	Linn.
Commelina nudiflora	....	....	Linn.
Monochoria hastaefolia	....	....	Presl.
„ *vaginalis*	....	....	Presl.
Limnocharis flava	....	....	Buch.
Sagittaria guayamensis	....	....	H.B. & K.
Hymenachne myuros	....	....	Beauv.
Isachne australis	....	....	R. Br.
Leersia hexandra	....	....	Swartz.
Scirpus grossus	....	....	Linn.
„ *supinus*	....	....	Linn.
„ *erectus*	....	....	Poir.
„ *mucronatus*	....	....	Linn.
Eleocharis variegata	....	....	(Burm) Vahl.
„ *fistulosa*	....	....	Schultes.
„ *ochrostachys*	....	....	Steud.

Eleocharis chaetaria	....	....	Roem.
Fimbristylis miliacea	....	....	Vahl.
„ *globulosa*	....	....	Kurth.
Cyperus spp.	....	....	Spp.
Kyllinga monocephala	....	....	Rottb.
Utricularia flexuosa	....	....	Vahl.
Ipomaea reptens	....	....	Poir.
Eichhornia crassipes	....	....	Solms.
Marsilia minuta	....	....	Linn.
Enhydrias aungustipetala	....	....	Ridl.
Chara gymnopitys	....	....	Brann.

The first 8 of the above are broad-leaved plants and have been controlled in padi fields experimentally with considerable success, by 2-4D preparations. The sedges were, in one case only, sufficiently affected by 2-4D or methoxone to give appreciable control, but the grasses were immune, and also the submerged weeds were out of reach. Hormone weed killers have not therefore given indications of being an effective and economic substitute for hand weeding. Where the mechanisation of padi growing is contemplated the suppression of weeds is of major importance, and the maximum effect must be achieved by tillage methods and water control.

In water courses, great obstruction can be caused by *Utricularia flexuosa* (bladderwort), and the submerged *Enhydrias angustipetala* and *Chara gymnopitys,* which three are collectively known as *lumut* (moss) by the Malays. The coarse water grass *Hymenachne myuros* also chokes ditches. Hormone weed killers are effective against none of these. Copper sulphate may have some success against the algae, and in general where there is no need for selective action as in drains, there is scope for chemical herbicides, but the danger of killing fish and fish food must be reckoned with. The fish of padi fields are of much economic importance. In comparatively still water, water hyacinth, *Eichhornia crassipes,* is a serious pest, against which 2-4D preparations have a strong effect. In experiments in Kedah an emulsion of 2-4D ester gave a complete kill with a sufficiently heavy dosage. In Malacca the sodium salt gave good control, but in the case of the ester, a second treatment was needed to deal with regrowth. The experience in Kelantan was that much regrowth occurred unless repeated treatments were made.

While considering water courses, it may be mentioned that in anti-malarial work, it is often desirable to have a herbicide incorporated in the oil used for anti-larval spraying, so that weeds on the verges of drains and streams are simultaneously prevented from providing shade, and visual evidence is provided that the treatment has been carried out.

A REVIEW OF PROGRESS RECORDED IN THE UPGRADING AND BREEDING OF PEDIGREE IMPORTED AND LOCAL GOATS.

BY

G. S. KEEPING.

Agricultural Officer (Research).

In 1946, as part of the overall livestock policy of the Department of Agriculture, it was decided that a programme of investigations into the upgrading of the goat population in Malaya should be undertaken.

The goat is a hardy animal, and good types are capable of giving high yields of milk in relation to their body size. Their housing and feeding is neither complicated nor expensive, and they are relatively cheap to purchase and quick to breed.

Pedigree Importations.

It was decided to import two males and two females of the three breeds most commonly met with in the United Kingdom. These breeds are British Saanen (Plate I and II), British Alpine (Plates III and IV) and Toggenberg (Plates V and VI.)

Six male goats were received in March, 1947; two of each breed. Two died within a short time, a British Alpine and a Toggenberg, but the rest survived, and are still in good health.

Owing to difficulties in arranging purchase and shipment, the female goats did not arrive until much later. In March, 1948 a British Alpine and a Toggenberg doe arrived, and in April, 1949 two British Saanen, a British Alphine and another Toggenberg were received. One of the British Alpines died in March, 1950 without ever having kidded and a British Saanen died in August, 1950, having produced a single male kid only. The remaining four does are in excellent health and have all produced one or more kids, or are at present in kid.

Local goats purchased.

In 1948 it was decided to purchase a number of local goats to mate with the imported pedigree bucks. Four young females, typical of the kampong type found in Selangor were first purchased (Plate VI), and these were then supplemented by two Nubian types purchased from Trengganu, one of which proved to be in kid and produced twin females. In 1950 six more Nubian type females were purchased from Trengganu, one of which kidded shortly after arrival.

Half-bred, three-quarter-bred and pure bred progenies.

The first half-bred progenies to be produced were born in December, 1949 as a result of a mating between a Toggenberg male and a Nubian type female (Plate VII). Twin females were produced, both of which were successfully reared. Early in 1950 twin half-bred Saanen females

were purchased from a labourer at Serdang (Plate VIII). These females were the result of a mating between a local doe and a Saanen male. In July, 1950 three-quarter-bred Saanens, a male and a female, were born, the result of a mating between a half-bred Saanen female and a pure bred male. By the end of September, 1950 a total of 18 half-bred and three-quarter-bred animals had been born.

The first pure bred progeny, a British Alpine female, was born in April, 1949, the result of a kidding by one of the imported does. This was followed in May, 1949 by a British Saanen male, and in June, 1949 by a Toggenberg female. No further births occurred until July, 1950. when a pure bred Toggenberg male was born. (Plate IX). Later in July, triplets, two males and a female, were born to the British Alpine doe (Plate X) and in September twin females were born to a locally bred British Alphine, and a single male kid to a Toggenberg doe. Tables I and II show half-bred, three-quarter-bred and pure bred progenies born since 1948.

Table I.

Half-bred and three-quarter-bred Progenies.

Sire	Dam	Progeny
Saanen 1	Local	Twin females (half bred)
„ 2	Half bred Saanen	Twins, one male, one female (three-quarter bred)
„ 1	Local 53	Twins, one male, one female (half bred)
„ 1	Nubian type 58	Twins, one male, one female (half bred Nubian/Saanen)
„ 2	Half bred Saanen 102	Triplets, two males, one female (three-quarter breds)
„ 2	Nubian type 56	Single female (half bred Nubian/Saanen)
Toggenberg 7	Local 51	Twins, one male, one female (half bred)
Saanen 2	Local 60	Twins, one male, one female (half bred)
Toggenberg 7	Nubian type 57	Twins, both females (half bred Nubian/Toggenberg)

Table II.

Pure Bred Progenies.

Sire	Dam		Progeny
Saanen	Saanen	3	Single male
British Alpine	British Alpine	4	Single female
Br. Alpine 8	British Alpine	4	Triplets, two males, one female
Br. Alphine 8	British Alpine	5	Twins, both females
Toggenberg	Toggenberg	10	Single female
Toggenberg 7	Toggenberg	10	Single male
Toggenberg 7	Toggenberg	6	Single male
Saanen 1	Saanen	9	Twins, one male (died) and one female.

Milk Records.

Comprehensive daily milk records of all goats in milk have been kept since January, 1949. Goats are milked twice daily and milk is

recorded in ounces. These milk records have already shown several interesting facts. The heaviest and most consistent milkers to date have been British Alpines, followed closely by the Toggenbergs, and Saanens. Among the local goats, the Nubian types have been vastly superior to the West Coast local goat. No three-quarter-bred and only two half-breds have so far been in milk, but their milk yield was disappointingly low. The local goats themselves show considerable variation in milk yield, some of them being so poor that they are difficult to record. Table III shows the milk yield in lbs. of all goats which have been in milk up to 31.10.50.

Table III.

Milk Yields and Length of Lactation.

Goat No.		Date Kidded.	No. of days in milk.	Total Yield (Lbs.)	Average Yield per day (Lbs.)	Remarks
British Alphine	4	12. 4.49	253	1179	4.7	
British Alphine	4	21.12.49	200	761	3.85	
British Alphine	4	17. 7.50	106	643.5	6.5	Served 29.9.50 and now in kid.
Toggenberg	6	5. 9.50	57	241	4.2	Yield increasing daily.
Toggenberg	10	8. 7.50	116	683	5.9	
British Alpine	5	4. 9.50	58	210	3.6	First lactation.
Local	53	18. 7.50	105	233	2.2	Served 16.9.50 and now in kid.
Local	55	12. 8.50	81	115	1.41	Lactation not yet completed.
Local (Nubian)	58	30. 7.50	94	389	4.1	Served 7.10.50 and now in kid.
Local (Nubian)	57	31.12.49	153	235	1.5	
Half bred	101	27. 2.50	93	61	0.65	
Half bred	102	9. 2.50	84	76	0.9	
Half bred	102	4. 8.50	89	96.5	1.1	Lactation not yet completed.
Local	56	8. 8.50	85	80	0.94	- do -
Local	51	17. 8.50	73	99	1.4	- do -
Local (Nubian)	64	5. 9.50	57	152	2.7	- do -
Saanen	3	11. 5.49	309	1426	4.6	- do -

As far as milking capacity is concerned, two factors are of prime importance. These are:—

(1) The length of time the doe remains in milk after having kidded.

(2) The total yield of milk produced during the lactation period.

The outstanding goat in the herd, to date, has been British Alpine No. 4. This doe remains in milk right up to the day on which she kids, after which she continues producing with renewed vigour. She is at

present in her third lactation, and is yielding substantially more than in her first and second lactations. This tendency to continue the lactation period up to within a day or so of kidding has likewise been noticed with both Toggenberg and British Saanen does. By contrast, local doe No. 56 has been in milk only 85 days, and her lactation has practically ceased.

Local (Nubian type) goat No. 58 has yielded excellently. She has been in milk for 94 days, and has shown no sign of drying off in spite of the fact that she is due to kid in another four months.

Of the "pure" local goats, No. 53 has given the best yield to date, and is still milking quite well. However, only four local goats have so far been milk recorded, and there can be little doubt that considerable variation in milking capacity does exist in this type of animal.

Live Weight Gains.

While the programme of improvement in goats undertaken by the Department has been mainly concerned with improvement in milk yields, improvement in live-weight and live-weight gain is also important. The typical local goat is a small and hardy animal, the female rarely exceeding 50 to 60 lbs. live-weight (except when in kid) and the male 90 to 120 lbs. Nubian type local goats found in Kelantan and Trengganu are much larger animals, the females frequently being as heavy at 100 to 120 lbs. Goats of the improved European breeds are much heavier, females sometimes reaching 150 lbs. and males 250 lbs. live-weight.

It is more than probable that there exists a fairly strong correlation between body weight and milk yield; a small animal is only able to consume a small quantity of food per day, as compared with a larger animal. Thus, assuming the efficiency of the animals is the same, the good small goat will never be able to produce as large a quantity of milk as a good large one. In the early stages of milk improvement therefore, increases in milk yield should automatically lead to increases in live-weight and live-weight gains. This does not mean that the ideal milk producing goat will also be the ideal meat producer, in fact, that is unlikely to be the case, but that rapid improvements in live-weights should be made in the early stages of selection for milk.

Table IV shows live-weight increases recorded and average live-weight gains per day for imported, half-bred and three-quarter-bred goats. In all cases goats were fed *ad lib* on a standard ration. None of the females recorded were in kid.

Table IV.
Live Weight Gains of Pure Bred, three-quarter-bred, half-bred and quarter-bred Goats.

Goat No.	Weight at birth (Lbs.)	No. of days to reach 50 lbs. live-weight.	Average live-weight increase per day (Lbs.)	Remarks.
Saanen 2 (Male)	8	96	0.44	
B.A. 13 („)	7½	110	0.39	
B.A. 14 („)	7	116	0.37	
Toggenberg („)	7½	120	0.35	
Toggenberg 18 („)	9	—	0.30	At 56 days old weighed 26 lbs.
Half bred Saanen/ Nubian 110 (Male)	7½	—	0.32	At 92 days old weighed 37 lbs.
B.A. 5 (Female)	8	140	0.30	
B.A. 15 („)	5	—	0.25	At 106 days old weighed 32 lbs.
B.A. 16 („)	7	—	0.28	At 57 days old weighed 23 lbs.
B.A. 17 („)	6	—	0.28	At 57 days old weighed 23 lbs.
Three-quarter bred Saanen 107 (female)	5½	—	0.23	At 115 days old weighed 32 lbs.
Half bred Togg/ Nubian 103 -	7	151	0.28	
Half bred Togg/ Nubian 104 -	5½	151	0.29	
Half bred Saanen/ Nubian 109 -	7	—	0.30	At 92 days old weighed 35 lbs.
Half bred Saanen/ Local 108 -	7	—	0.25	At 92 days old weighed 30 lbs.
Quarter bred Saanen 105 -	5	218	0.21	
Quarter bred Saanen 106 -	5½	270	0.16	
Quarter bred Togg. 59	6	290	0.15	

It will be observed that the best live-weight gains have been made by the pure bred progeny of imported goats, and that the gains recorded by the Saanen/Nubian type half bred males are excellent. Of the females, the pure bred progeny of imported goats have made the best live-weight gains, while the half-bred Toggenberg and Saanen/Nubians have recorded good increases. No figures for average live-weight gains of local goats are available, but figures for quarter-bred Saanens and Toggenbergs are given, and are very poor. It will be noticed that the quarter-bred Toggenberg female takes almost twice as long to reach 50 lbs. live-weight as the half-bred Toggenberg/Nubian.

Feeding Systems.

All goats at Serdang are stall fed and they are allowed out for exercise only. The food consists of two main parts, firstly the fodders, or bulky part of the ration, made up of cut grass and the leaves of certain trees, and secondly, the concentrate part of the ration.

A number of grasses and fodders have been tried for goats, and the animals appear to relish a large variety of herbage. Of the grasses, guinea grass (*Panicum maximum*) appears to be eaten most freely, although napier grass, (*Pennisetum Purpureum*), if cut young, is also relished. Jack fruit leaves (*Artocarpus heterophyllus*), *tembusu* leaves (*Fagraea Fragrans*), young branches of *Enterolobium cyclocarpum* and *Leucaena glauca* are all eaten freely, as is " stylo " (*Stylosanthes gracilis*) and various *Alysicarpus Spp.* It should be remembered that the goat is typically a browser, and not a grazing animal, and for this reason fodders should be tied in bunches and attached to the pen at about the shoulder height of the animal, thus enabling it to " browse " from the tied bundle.

The concentrate part of the ration may be made up of a number of foods, such as coconut cake, groundnut cake, soya beans, Bengal gram, maize etc. The ration fed at Serdang is as follows:

Maize (kibbled)	6	parts
Bengal gram (cracked)	1.5	„
Soya beans (cracked)	1.5	„
Copra cake	1	„
	10.0	parts

The amount and type of food a goat receives will depend on:—

(a) its live weight
(b) its milk yield
(c) its age and condition.

For mature goats of up to 60 lbs. live-weight a ration of 4 to 5 lbs. fodders, plus ½ lb. of concentrate mixture per day will be quite sufficient. For larger animals of up to 120 lbs. the fodder ration remains the same, but the concentrate ration should be raised to 1 lb. per day, while for a mature male of about 200 lbs. live-weight fodder ration should be 6 to 7 lbs. per day and concentrate ration at least 3 lbs. per day.

Goats in milk are fed at the rate of approximately 1 lb. of the concentrate ration for every ¼ gallon of milk produced daily. Thus, a doe yielding ½ gallon milk daily would receive 2 lbs. of concentrate ration in addition to any quantity fed to her for maintenance. A typical ration for a doe weghing 120 lbs. and yielding ½ gallon of milk daily, would be as follows:—

Maintenance	Fodders	4 to 5 lbs. daily
	Concentrates	1 lb. „
Milk production	Concentrates	2 lbs. „

Does in kid, and young growing animals require rather more generous feeding than mature animals, and all growing stock should be allowed as much fodder as they will eat, plus a generous concentrate ration, per day. In-kid does should be allowed an extra 1 lb. of concentrates per day after the second month of pregnancy.

Owing to the prevailing high temperature experienced in Malaya, stock of all kinds tend to lose more water through the skin than in tem-

perate climates, and for this reason it is essential that goats should be allowed a plentiful supply of clean drinking water. Furthermore, losses of salt are heavy in the tropics, and a salt-lick should be allowed each animal. In addition 3 per cent. of an iodised mineral mixture is added to the concentrate ration of all goats at Serdang, and this helps replace various minerals which are either not present in the food naturally or are lost through the skin owing to the high rate of perspiration.

Housing.

At Serdang all goats have been housed in wood and *atap* buildings raised some 2 to 2½ ft. above the ground (plate XIII). A large house is set aside for milking does, which are kept in separate pens measuring 6½ x 4½ ft. Adult males are housed in a further building with rather larger individual pens, which is of stronger construction than those used for milking does. Young stock are also housed separately in large pens, measuring 10 x 5½ ft., with four or five kids per pen, the number per pen being reduced as the kids mature. In-kid does should always be allowed individual pens, since otherwise fighting often occurs, and abortions may be caused.

Goats appear to be inordinately fond of *atap*, and if precautions are not taken, will literally eat the roof from over their heads. To avoid this wire netting should be stretched beneath the *atap*.

Corrugated iron is not suitable as a roofing material for goats, since it renders the house very hot during the middle of the day. Corrugated aluminium sheet, on the other hand, is an ideal material for roofing goat houses, and does not appear to render the houses hot during the day. Although initially expensive, it is likely to be cheaper than *atap*, at least in Selangor, since it should last 10 to 15 years as against the 2 to 3 years for attap.

Each pen should be provided with a rack to which bundles of fodder etc. can be tied, and a container for concentrates. This latter should be easily removable for washing and cleaning.

Any type of housing for goats should be designed to keep the animals dry but cool. If possible, houses should be erected close to mature shade trees, but if this is not possible, young trees should be planted to provide shade as they mature.

Breeding.

The normal gestation period of the goat is about 150 days. The local goat will usually produce two sets of kids a year, that is, it can be mated quite soon after kidding, and oestrus may occur at any period during the year. Goats of the European breeds, on the other hand, seldom produce more than one set of kids per year in their natural environment and oestrus usually commences in September to November. This fact has led to some difficulty with breeding imported goats in Malaya, especially since it has been the object of the Department to breed from the imported does as rapidly as possible, and thus build up a herd.

PLATE I.

Young British Saanen Buck.

PLATE II.

Mature British Saanen Doe.

PLATE III.

Mature British Alpine Buck.

PLATE IV.

Young British Alpine Doe.

PLATE V.

Mature Toggenburg Buck.

PLATE VI.

Mature Toggenburg Doe.

PLATE VII.

Half-bred Nubian Toggenburg female, aged 9 months.

PLATE VIII.

Half-bred (local female/British Saanen male) Doe.

PLATE IX.

RIGHT. Pure bred Toggenburg Buck, aged 2½ months.
LEFT. Half-bred (British Saanen/Nubian) Buck, aged 2 months.

PLATE X.

Twin British Alpine Males, aged 2½ months.

PLATE XI.

Typical "Local" Goat of good type.

PLATE XII.

Nubian Type Local Goat.

PLATE XIII.

Goat House of the type used at Serdang.

Oestrus can be induced in does which fail to come on heat over a period of some months by intramuscular injections of stilboestrol, and this method has been used successfully at Serdang, but care is necessary, and injection is best done by a Veterinary Officer. Injections are given at 24 hourly intervals, and oestrus usually commences after the first or second injection. Frequently, does fail to become pregnant after the first service following a stilboestrol injection, but normally the drug has the effect of starting a cycle of oestrus, in which case the animals will hold to the second or third service.

In normal circumstances, it is probably not desirable to produce more than one set of kids from an imported doe each year, since the lactation period of such does is prolonged, and the strain of producing two sets of kids, plus a heavy yield of milk at the same time, is bad for the health of the doe. One of the British Alpine does, for example, kidded in April, 1949, and in the following 365 days produced two sets of kids and 1,660 lbs. of milk, which was undoubtedly a heavy strain on the animal. But with local does it is desirable to produce two sets of kids a year, since the lactation period is rarely more than three months and the yield is very low, so that the faster the animal kids, the more rapidly will she be brought into production again.

Artificial insemination has been tried with complete success and may be very advantageous in the future for mating animals separated by moderate distances.

Summary.

The history of the various importations of pedigree goats made by the Department of Agriculture since the war is discussed, and notes on the progeny resulting from their crossing with local animals are recorded. Milk yields, live-weight gains and average live-weight gains per day are discussed. Points on the housing and breeding of goats in Malaya are considered.

MECHANIZATION

Quarterly Progress Report, October to December, 1950.

Compiled by the Acting Senior Agricultural Officer (Research) and the Agricultural Officer (Engineering).

Recent Importations.

The following implements and machines were received during the period under review:—

McMahon lift-type disc harrow for Ford and Ferguson tractors.
Towner offset disc harrow for Ford and Ferguson tractors.
Twose mounted fertilizer distributor for Ferguson tractors.
Allmans self-propelled " Pest-Master " dusting machine.

Tests and Modifications.

The Oliver T.N.T. Subsoil Plough.

The Oliver T.N.T. is a 2-furrow digger plough with special shares mounted beneath the main bodies to break up and partially invert the sub-soil. It is well made and is fitted with a reliable self-lift which raises the sub-soil shares sufficiently high above the ground to avoid choking while turning on the headlands. An adjustable spring safety hitch is fitted to the draw-bar.

The T.N.T. has been used to plough up old pasture at the Federal Experiment Station, Serdang, and has been found to be an extremely efficient plough. The maximum depth of working that has been achieved is 12 ins. the top 8 ins. of which were turned by the main bodies. The inversion of this upper layer was complete and the vegetation was completely covered. The sub-soil was " stirred " to a depth of about 4 ins. over about a half of the furrow width.

Working at a total depth of 12 ins. in fairly sandy soil the draught of the T.N.T. was about 2,700 lbs., which was beyond the capabilities of a Fordson Major, but the plough was easily pulled by a D4 Caterpillar tractor.

Subsoiling ploughs of this type are likely to prove useful where a pan has been formed by repeated ploughing at the same depth, where deep cultivation is required in areas with only a shallow top soil and where " cracking " of the subsoil is required to improve water percolation.

The Ferguson Disc Plough.

The Ferguson disc plough is a 2-furrow implement designed for the three-point linkage of the Ferguson tractor hydraulic lift. As with the Ferguson mould-board ploughs, no depth control is fitted, the working depth being controlled by the constant draught arrangement of the hydraulic lift mechanism.

The disc plough was compared with the normal 2-furrow mould-board plough on a pasture field at the Federal Experiment Station, Serdang. With extra ballast added, it was found that the disc plough

could penetrate to a depth of seven ins. but speed of working was higher than that obtained with the mould-board plough.

The disc plough furrow slice was more broken and not so completely inverted as that from the mould-board plough, and the vegetation was not covered.

Further experiments with the disc plough under rough conditions and in *belukar* are planned, but it is thought that, because of the incomplete inversion, the disc plough will not prove as satisfactory for *lalang* control as the Ferguson single-furrow deep digger mould-board plough, which has recently done excellent work in fairly heavy *belukar* at the Federal Experiment Station, Serdang.

Reconditioned Shares.

A 2-furrow mould-board plough has been fitted with one of the reconditioned plough shares described in the July-September, 1950 progress report. Neither share is yet worn out but the reconditioned share is lasting at least as well as the new one.

The Cuthbertson Disc Cultivator.

This machine, designed for the inter-row cultivation of sisal was loaned to the Department by an estate in Selangor. It consists of a very rigid metal frame on which are mounted four pairs of 30 ins. diameter flat metal discs. These are carried at the ends of fabricated steel arms, which can pivot independently of each other. Twelve steel cutters are welded at right angles on to each disc, and the edges of both discs and cutters are protected by a bead of wear-resisting welding alloy.

The upper part of the framework is in the form of a trough in which sand, stone or scrap metal ballast can be carried to increase the penetration of the cutting edges. During the tests, 2,500 lbs. of scrap metal ballast were carried, but this was removed when the machine was being moved over earth roads, and very little damage was done to road surfaces.

It was found that, when heavily ballasted, the cultivator could only be pulled by a Fordson Major under ideal conditions, and throughout the test it was used with a D4 Caterpillar tractor. It was first tested, in dry weather, on a gently sloping field of old oil palms. The ground cover consisted of short grasses and mixed annual weeds and creepers and there were heaped rows of old fronds and trash at intervals. The cultivator surmounted all obstructions such as heaps of fronds and rotting palm stems and chopped up the surface cover without any soil-inversion. In a subsequent test in the Serdang arboretum, where the cover consisted of light *belukar* with *lalang*, the implement was less successful. The cover was crushed and flattened but the effect was not lasting and the rate of working was low, varying from ½ to ¾ acre per hour.

The Towner off-set Disc Harrow.

This is an American implement designed for the Fordson tractor but it can be fitted to the power lift of the British-made Ferguson. It

is a heavily built machine with two gangs, each of six 22 in. diameter discs.

Tests so far have been confined to nursery and orchard conditions where it was able to deal successfully with a heavy cover. However, it may well prove unsatisfactory under estate conditions because, with the implement in the raised position, the tractor is unstable and the front wheels tend to leave the ground on hills or when crossing shallow drains.

Speed Spinner for the Ferguson Tractor.

A seed spinner has been developed for the Ferguson tractor in Province Wellesley. Mounted high on the rear of the tractor, the unit consists of a hopper with control gate, and a disc mounted on the shaft of a 6-volt electric motor. The seed is fed from the hopper on to the spinning disc and is distributed in a wide swathe.

The disadvantage of this type of seeder is that seed distribution is uneven but its light weight and simplicity of operation may well outweigh this disadvantage for sowing wet padi.

Work is proceeding on the prototype with a view to improving seed distribution and to providing more accurate control of seeding rate.

The Weedmaster Low-Volume Sprayer.

The Weedmaster is a direct-mounted low-volume sprayer designed primarily for applying hormone weed killers. It can be fitted, with minor modifications, to either the Fordson Major or Ferguson tractors. The main component of the sprayer is a 45-gallon tank, which carries the two 8-ft. booms, control valves and gauges. The gear-type pump is mounted below the tank and is driven from the tractor power-take-off shaft through a rubber connector.

Great care has been taken by the manufacturers, Pest Control Ltd., to prevent possible damage through corrosion. The pump has a gunmetal casing, bronze gears and a stainless steel shaft. All castings are of gunmetal, and the insides of the tank and booms are protected with a bituminous compound and heavy galvanizing respectively.

Five patented "Teejet" spray nozzles, which give a fine, fan-shaped, even spray are fitted to each boom. The height of the booms can be adjusted from 15 to 36 ins. above the ground, and the control valves allow either boom to be used independently of the other. Both booms can be side-mounted, on either side, for roadside spraying.

Under test it was found that, at the tractor's rated engine speed of 1,500 r.p.m., the sprayer delivered approximately 50 gallons of spray per hour at a pressure of 39 lbs. per sq. in. The width of spread was 19 ft. 3 ins. with the boom at 15 ins. above ground level. With a forward speed of about 3½ m.p.h. approximately 6 gallons per acre were applied.

Some difficulties were experienced in making the various joints of the sprayer water-tight since many of the castings were by no means accurate. The inner end of one of the spray booms was fractured by vibration during the preliminary trials, but after it was repaired no further trouble occurred.

The Allen-Noblox Sprayer.

The Allen-Noblox sprayer attachment for the Allen motor scythe is fitted to the front of the chassis in place of the cutter bar. The double ended ram piston is driven by the cutter-bar pitman, and reciprocates in two opposed cylinders. Apart from two cup-shaped seals on the piston there are no glands to develop leaks and the unit should prove very reliable.

The pump is equipped with vortex type spray lances but no tank is supplied. In trials in Province Wellesley a 12-gallon tank was mounted above the engine of the motor scythe to hold the spray mixture.

This equipment was used for experimental applications of an aromatic oil in water suspension. Vibration of the motor provided sufficient agitation to prevent separation of the two liquids and the sprayer worked quite satisfactorily, except that the natural rubber hoses, as was expected, deteriorated rapidly.

Investigations into Wet Padi Cultivation.

Cultivation and planting of mechanical cultivation experiments in Province Wellesley, Malacca and Kelantan have been completed. In the "Wet versus Dry Cultivation" experiment in Kelantan it is reported that crops grown on land prepared while wet are conspicuously better than those on land cultivated while dry. No other visual differences have been reported.

Investigations into Dry Land Cultivation.

Terracing.

The terracing experiment in Johore has been completed, but details of rates of working and costs have not yet been received.

Pasture and Fodder Grass Cultivation at the Federal Experiment Station, Serdang.

The Russell Multiplanter described in the July to September, 1950 progress report has been used successfully for planting 6 acres of Guinea Grass and 5 acres of Carpet Grass at the Federal Experiment Station, Serdang. Through cultivation of the soil before planting is most important and, where a good fine tilth has been obtained, few difficulties have been encountered and the working rate has been from ¼ to 1/3 acre per hour.

Most of the transplanted grass is now growing well and inter-row cultivation with a Fordson Major rowcrop tractor has commenced. Two "L" hoes and one "A" hoe are used between each row. The hoes were set at an acute angle so that the soil can be thoroughly shaken away from the weed roots. Apart from the difficulty of finding operators who can concentrate on accurate driving, no difficulties have been encountered and working rates of from ½ to ¾ acre per hour have been maintained.

NOTES ON CURRENT INVESTIGATIONS, OCTOBER TO DECEMBER, 1950.

Compiled by the Acting Chief Research Officer and the Senior Agricultural Officer (Research).

Padi.

The variety collections at Kota Bharu, Pulau Gadong, and Titi Serong Padi Experiment Stations are growing satisfactorily and are subject to continual study. Variety selection is proceeding at each Station concerned on Serendah Kuning (Negri Sembilan), Nachin and Siam (Malacca), Radin Ebos (Kedah), Mayang Sa Batil (Penang), Seraup (Krian). Acheh Puteh lines have been planted at Panchang Bedena (Selangor) and a fresh start has been made at Sungei Burong with a further foundation stock of that variety. Preliminary field trials in the 1949-50 season at Jasin (Malacca) with some of the most promising lines of Serendah Kuning from Negri Sembilan produced a yield of approximately 650 gantangs per acre from the selection Serendah Kuning (Kendong) No. 3. This result has evoked a local demand for seed. Current variety trials are proceeding well at most Stations.

The manurial experiments undertaken in the present season in various parts of the country, numbering 76 in all, are progressing satisfactorily except in a few instances when affected by adverse weather. At this stage marked response in vegetative growth can be observed which may or may not be reflected in the ultimate yields of grain. Cultivation experiments are largely combined with manurial experiments, but at Kota Bharu there is a conspicuous vegetative response on plots mechanically cultivated in the wet compared with those cultivated in the dry.

Experiments on dry padi at Melor, Kelantan, reveal pronounced effects of fertilisers and late deep cultivation.

Numerous specimens of unhealthy padi plants from various localities were submitted for pathological and chemical examination. The disease usually named " penyakit merah" was prevalent. It is recognised as primarily a physiological disease, a common symptom being poor development of the feeding root system and a deposit of iron oxide in the cortex of the roots and the outer leaf sheaths. Some unhealthy plants at Dong Padi Station, Pahang, exhibited a white fleck on the leaves which was first investigated as a possible disease symptom but was eventually traced to the effect of a sucking insect ~~*Erythroneura*~~ sp.

Cacao.

Trinitario.

Selection is in progress in a large estate block which has begun to come into bearing, and records are being maintained on the Departmental plots. The second clonal trial of plants raised from cuttings from selected Serdang and Cheras trees has been partially planted out. There will eventually be eighteen clones under test, in plots of 9 trees each.

Breeding amongst the selected trees has now produced progenies each represented by 80 legitimate seedlings now in baskets. The field for their reception is being prepared. Controlled pollination of the trees is continuing.

A comparative trial of Trinitario and Criollo has been planted in secondary jungle rentices at Serdang which will also give information on the merits of this method of planting. A further importation has been made in the form of 28 seedlings of I.C.S. Clone No. 1 which had been raised at Kew.

Criollo.

Some further progress has been made in the programme of budding *kampong* Criollo upon established Trinitario plants at Serdang, but an efficient technique in the circumstances has not yet been achieved. Stocks which died after budding failure are being replaced. Of the illegitimate seedling progenies of *kampong* Criollo, 31 have been planted in a replicated trial, with 20 other progenies represented in discards.

Amelonado.

The West African Amelonado plants at Serdang are jorquetting at a height of about 5 ft. In a preliminary trial it has been found possible to take buds from the main stems of these plants without ill effect. It is hoped by this means to be able to accelerate the multiplication of Amelonado material, budding it upon Trinitario seedlings.

Vegetative propagation.

Experience is being gained in the use of the continuous spray open air propagator for cuttings, and a modification found necessary is the use of a coarser grade of sand, to correct previous inadequate drainage.

Pest control.

The result of an insecticidal experiment at the Rubber Research Institute Experiment Station, Sungei Buloh, where young Trinitario plants were sprayed at weekly intervals, has showed that Accotox (wettable D.D.T.) gives better control of *Apogonia* than all other insecticides used except lead arsenate. It is probable that if spraying was less frequent, lead arsenate would have the advantage over Accotox as being more lasting.

Oil Palm.

Selections are being made amongst Pisifera and Tenera plams at the Federal Experiment Station, Serdang, for the purpose of breeding for the Tenera type, which has been neglected in Malaya, all commercial planting being done with Dura type palms. Tenera-Tenera and Dura-Pisifera seed has been received from Nigeria. Pisifera pollen, also from Nigeria, has been applied to dumpy (i.e. Dura) plams. Controlled pollinations have been made between dumpy and Serdang Pisifera and Tenera. The normal programme of controlled pollination for breeding from selected dumpy and tall palms has continued.

Germination trials have been in progress for a considerable time, with a view to correcting the rather poor germination to which pedigree seed has been subject. Definite conclusions which emerged were that soaking the fruit in stagnant water before removing the pericarp was a more effective treatment than soaking in a stream, and that a sand bed overlying compost was better than a normal sand bed. A second trial to test other conditions of germination has been laid down.

A replanting experiment was laid down at the Federal Experiment Station, Serdang. Three of the four experimental blocks were planted with 1214 legitimate seedlings, and the fourth block will be planted early in 1951. The main treatments to be tested are felling the old palms before replanting, and felling them one, two, and three years after replanting. The felling for the first treatment was carried out by two heavy track tractors with combined winching and dozing operations. A manurial experiment is superimposed upon the main treatments, taking the form of a N.P.K. factorial design.

Quarterly analysis of leaves of palms of pedigree families which were given a dressing of complete fertilisers has shown that difference in K_2O/P_2O_5 ratio between a healthy family and a family subject to severe leaf bronzing, has narrowed appreciably. Hydroponic experiments on oil palm seedlings with different proportions of nutrients are in progress. In one of these, soluble aluminium is being added in increasing small amounts, but no harmful effect has so far been observed. In view of the preference of oil palms for acid nutrient solutions, seedlings have been grown in soil of pH 4.3 and in the same soil limed to pH 8.1 and pH 9.0 respectively. Those in normal soil grew very well, but those in the limed soil were not healthy, and in the case of the more alkaline soil, most of the leaves died.

Further cases of leaf rot of young palms have been encountered, and investigation of the cause is continuing. Another outbreak of bending of fronds has been reported. As usual the bent fronds may remain green for months, but if, as a result of cracking, *Thielaviopsis* sp. or *Poria Ravenalae* invade the tissue, premature leaf withering results. Palms so affected are weakened and may be attacked at the base and killed by stem or fungi. No case of *Fusarium* vascular wilt or other fungus disease was observed. The original trouble may be physiological and a manurial treatment is being given experimentally.

Tea.

The manurial experiment at the Federal Experiment Station, Serdang, continues to show response in yield of green leaf to increased dressings of nitrogen. A similar experiment has commenced at Cameron Highlands after one year's examination of the pre-treatment yields from the intended plots. On another area at Cameron Highlands nine months' records of pre-treatment yields have indicated that its uniformity is adequate for a factorial N.P.K. manurial experiment to be started.

Observations on the incidence of Blister Blight were continued at Cameron Highlands. The disease was not much in evidence in September

but became more prevalent during October, and by the end of November was approaching the peak reached in April-May, 1950.

Coconuts.

An outbreak of *Artona catoxantha* of unprecedented severity occurred on coconuts in north Perak, and was characterised by an abnormally low degree of parasitism by *Ptychomyia*, which usually brings about natural control. The numerous unknown factors concerning this past were all too grievously evident as well as the hazards of using insecticides which affect the parasite as much as the pest, or more.

Fibres.

The best yield of jute, grown as an off-season crop at Sungei Burong in the Selangor Coast padi area, was at the rate of 15 tons per acre of freshly harvested material. The fibre content of this material estimated by sample retting was 2½ per cent.

Honkenya ficifolia was added to the collection of fibre plants at Serdang. Two ramie trials on peat were harvested but were disappointing. Twelve clones of ramie were selected from the numerous lines collected at Serdang.

A stem rot and bacterial vascular wilt have been recorded of Manila hemp. It has been suggested that poor growth of certain plants of Manila hemp is due to a chronic or attenuated form of "bunchy top," and it is proposed to carry out replantings from suckers of the more vigorous clumps.

Fodders.

A variety trial of Napier grass has been established and recording of yields commenced.

Stylosanthes gracilis is being multiplied at Serdang in preparation for a manurial trial, and quantities of planting material are being distributed to the Field Branch. In Kelantan a good establishment was obtained in ploughing, placing cuttings in the furrow slice and covering them with the next furrow.

The collection of imported clovers in a variety trial at Cameron Highlands is growing well on flat land but rather poorly on hill slopes.

Miscellaneous crops.

Rambutans.

In a variety trial at Degong, Perak, about 80 per cent. of the trees flowered in September, 2½ years after planting, and fruit is ripening. A few trees are coming into bearing in a similar trial at Serdang. The planting of another trial at Ipoh was completed in October.

Vegetables and Food Crops.

Thirteen variety, mulching, and manurial trials have been laid down at Kuala Lumpur. Tapioca variety trials were laid down in Malacca and Kelantan.

Soils.

Trials are being made to seek means of improving the soil and crops of the so-called deficiency area of Gual Periok, south of Repek,

Kelantan. These include methods of cultivation and application of fertilisers and trace elements.

A survey was made of the soil at Paya Besar near Kuantan, an irrigation area where yields of padi have been consistently poor, and colonists have been unwilling to remain. On account of poor drainage, most of the area is always waterlogged. The soil contained a large proportion of silt and fine sand. Characteristic of most of the area was that beneath a firm upper layer, there was a layer of very soft consistency, sometimes darkening on exposure to air. The lower horizons of the soil were highly sulphurous, with high conductivity and high loss on ignition. There was evidence of a good deal of organic matter having been buried by later deposits. The amount of "active" aluminium was very high, but it is known that there is fairly high active aluminium content in good padi soil in the Selangor coast irrigation area. Samples of soil from the proposed Paya Temai padi area (in Pahang) actually gave very low figures for this factor.

The soil of an area near Pahang Tua was surveyed to confirm its suitability for mechanical cultivation of padi and controlled irrigation. The rather sandy subsoil should serve to ensure efficient drainage.

The survey of soils of existing padi areas in relation to their yielding capacity has continued, embracing Kahang and Endau, in Johore, and the Tanjong Karang area in Selangor. Certain samples have been sent to the United Kingdom for spectro-chemical analysis.

Where convenient, a policy is being followed of observing the effect of crop experiments on the soil. Several experiments with rotations, fertilisers, and mulching treatments are subject to periodic soil examination.

Livestock.

Goats.

During the quarter, at Serdang, 5 pure-bred, 2 three-quarter bred, and 4 half-bred kids were born. One male Saanen kid died.

The pure-bred dogs in milk yielded a daily average of 4.7 to 6.1 lbs., whereas the best local doe yielded 2.1 lbs. A British Alpine doe has given milk continuously from one lactation to the next, quite unlike the local animals with their very short lactation periods.

Poultry.

A feeding and management trial is now in progress at eight Agricultural Stations.

Canning Research.

Attention has been given to testing instruments at the Canning Research Station, and rectifying faults and deficiencies which existed when delivered. A new tentative grading scheme for Malayan Pineapple was drawn up, and has been put into practice experimentally during the current season. A review of the preliminary results should be available for the next issue of this Journal. The Canning Officer has undertaken a large volume of advisory work on efficient canning management and operation of new and improved equipment.

Departmental Notes

New Year Honours.

Mr. J. J. Holmes, Assistant to Agricultural Economist, has been awarded the Colonial Police Medal for meritorious service with the Auxiliary Police.

Appointments.

Mr. J. R. Milburn has been appointed to be an Agricultural Officer, with effect from 11th November, 1950. On arrival in Malaya he was posted to the Federal Experiment Station, Serdang. He has since been seconded for duties connected with the Emergency.

Mr. J. A. Cox has been appointed to be an Agricultural Development Officer, with effect from 13th January, 1951.

Promotion.

The Right Honourable the Secretary of State for the Colonies has been pleased to approve the promotion of Mr. J. Cook, Agricultural Officer to be Senior Agricultural Officer, with effect from 1st May, 1950.

Transfers.

Mr. H. D. Matheson, Agricultural Officer, Perak South, was posted to the Federal Experiment Station, Serdang, as Agricultural Officer in Charge, with effect from 27th November, 1950.

Mr. H. J. Simpson, State Agricultural Officer, Pahang, was transferred to Perak, with effect from 2nd November, 1950.

Mr. H. M. James, Agricultural Officer, was appointed to act as State Agricultural Officer, Pahang, with effect from 2nd November, 1950.

Dr. W. N. Scott relinquished duty as Acting Principal, College of Agriculture, on 14th January, 1951, and assumed duty as Officer-in-Charge, Federal Experiment Station, Serdang, on 15th January, 1951.

Leave.

The following officers have proceeded on vacation leave:—

Mr. J. J. Holmes, Assistant to Agricultural Economist.
Mr. G. S. Keeping, Agricultural Officer.
Mr. J. L. Greig, Senior Agricultural Officer.
Mr. J. Fairweather, Senior Agricultural Officer (on leave prior to retirement).

The following officers have returned from leave:—

Mr. R. G. Heath, Chief Field Officer.
Mr. A. Johnston, Plant Pathologist.
Major O. M. Lee, Acting Principal, College of Agriculture.
Mr. H. K. Ashby, Senior Agricultural Officer.

Mr. Ashby has been seconded for duties in connection with the Emergency.

Retirement.

Mr. C. W. S. Hartley, Senior Agricultural Officer (Research) retired on medical grounds, with effect from 1st November, 1950.

Mr. J. Fairweather, M.B.E., Senior Agricultural Officer, proceeded on leave prior to retirement on 2nd December, 1950, after 30 years service in the Department.

Mr. Fairweather joined the Department in November, 1920, following service in World War I. He spent the first seven years of his service in Malacca where the memory of him is still green. Thereafter, he spent comparatively brief spells in Perak North, Penang and Province Wellesley and Pahang West prior to transferring to Johore in 1931. He remained in Johore up to the outbreak of the war against Japan in 1941, on several occasions acting as State Agricultural Officer. He was a civilian internee in Singapore from 1942 to 1945. He returned to Malaya, following post-internment leave, in 1946, and became State Agricultural Officer, Perak, a post he held until his retirement. He was promoted to the substantive rank of Senior Agricultural Officer in April, 1946.

The departure of "Jas" from the Department leaves a big gap. His wide experience of the agriculture of the country and his close contact with the people on the land enabled him to take a broad view of and to give correspondingly sound advice on local agricultural problems. In the social sphere he will likewise be missed by his many friends throughout Malaya. His colleagues in the Department hope that he and Mrs. Fairweather will enjoy a long and happy retirement.

R. G. H.

MARKET PRICES

October to December, 1950.

Rubber.—The highest Singapore price of No. 1 R.S.S., f.o.b., in bales, buyer, during the fourth quarter was 231 cents per lb. on the 10th November, and the lowest at 151 cents per lb. on the 2nd October.

October opened with the price at 151 cents per lb. increasing to 197 cents on the 31st and giving an average of 171.12 cents per lb. for the month. The price on the 1st November was 208 cents increasing to 231 cents per lb. on the 10th and giving an average price for the month of 196 cents. For December, the highest price was 191 cents per lb. on the 1st December, the lowest at 155 cents on the 12th, and gave an average of 172.02 cents per lb. for the month.

The average prices paid for smallholders' rubber at three centres in the Federation of Malaya during the fourth quarter of 1950 are given in Table I.

Table I.

Average Monthly Prices Paid by Local Dealers for Smallholders' Rubber, October-December, 1950.

(Dollars per picul of 133 1/3 lbs.)

Grades	Taiping, Perak.			Seremban, Negri Sembilan.			Batu Pahat, Johore.		
	Oct.	Nov.	Dec.	Oct.	Nov.	Dec.	Oct.	Nov.	Dec.
Smoked Sheet	205.00	235.00	206.50	209.00	243.00	202.00	187.30	218.50	162.80
Unsmoked Sheet	175.00	172.50	170.00	177.00	205.00	155.00	173.20	196.90	155.60
Scrap	67.00	67.50	72.50	72.00	88.00	60.00	54.60	53.80	51.25

Transport from Batu Pahat to Singapore by lorry, excluding duty, 80 cents per picul.

Tea.—The average price paid from 1st January to 30th December, 1950 in Colombo for Malayan tea, as quoted in the Colombo Brokers' Association weekly report dated 30th December, 1950, was Rs. 1.85 per lb. The average prices of Ceylon teas quoted in the weekly report of the same date, were as follows, in rupees per lb.: High Grown Teas Rs. 2.47, Medium Grown Teas Rs. 2.08, Low Grown Teas Rs. 2.20.

Ceylon teas are subject to an export duty but non-Ceylon teas sold at auctions ex-bond in Colombo for re-export are not subject to this duty.

The retail price for Malayan Tea (Boh) continues to be $2.25 per lb.

Palm Oil.—The majority of Malayan estate production of this commodity continues to be sold to the United Kingdom Ministry of Food. The price payable to producers is now £104 per ton f.o.b. Singapore. The 5 per cent. *ad valorem* Malayan export duty is for sellers' account.

Derris.—The price of this commodity as quoted in the weekly reports of the Singapore Chamber of Commerce dropped from $100 per picul on 2nd October, and remained at approximately $90 throughout the quarter.

Tobacco.—The average prices paid per picul for cured leaf in Kelantan during the fourth quarter of 1950 were as follows:—1st quality $666, 2nd quality $483 and 3rd quality $260.

Rice.—The ration of rice continues to be 3½ katis per person per week. Rice can now be purchased in three grades at the following prices per picul: High Grade $33, Medium Grade $26 and Low Grade $22.

Table II.

Singapore Prices of Various Agricultural Products.

(Dollars per picul)

Date	Copra, Sundried	Coconut oil *	Pepper, F.A.Q. Muntok white	Pepper, Gen. Muntok white	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
1950								
2nd Oct.	40.50	72.00	990.00	1000.00	70.00	21.50	18.00	16.00
9th Oct.	40.50	71.00	965.00	975.00	70.00	21.50	18.25	16.00
16th Oct.	41.50	72.00	965.00	975.00	72.00	22.00	18.25	16.00
23rd Oct.	41.00	72.00	935.00	945.00	73.00	22.00	18.25	16.00
30th Oct.	41.50	72.00	930.00	940.00	78.00	21.50	18.25	16.00
6th Nov.	41.50	73.00	925.00	935.00	75.00	22.00	18.25	16.00
13th Nov.	43.00	75.00	990.00	1000.00	76.00	21.50	19.00	16.00
20th Nov.	43.00	75.00	940.00	950.00	73.00	21.00	19.25	16.00
27th Nov.	43.50	75.00	930.00	940.00	76.00	21.50	19.25	17.00
4th Dec.	45.50	76.00	960.00	970.00	78.00	21.50	19.25	17.00
11th Dec.	44.50	75.00	970.00	980.00	76.00	21.50	20.25	17.00
18th Dec.	45.25	75.00	970.00	980.00	75.00	22.00	19.75	17.50
27th Dec.	45.50	76.00	985.00	985.00	74.00	22.00	21.00	18.00

* F.O.B.

The above prices are taken from the weekly report of the Singapore Chamber of Commerce.

FEDERATION OF MALAYA
PRODUCTION OF PALM OIL AND KERNELS.

(In long tons as declared by Estates)

Month	Palm Oil		Palm Kernels	
	1949	1950	1949	1950
January	3,793.0	3,958.5	799.9	896.0
February	4,007.0	3,643.1	821.4	969.9
March	4,055.6	4,860.6	860.1	1,184.0
April	3,999.3	4,918.5	808.3	1,249.0
May	4,120.9	4,433.0	809.2	1,086.3
June	4,321.5	4,226.4	791.2	1,070.0
July	4,461.3	4,360.6	931.0	1,069.5
August	4,398.2	4,585.9	906.0	1,192.5
September	4,234.9	4,084.7	858.9	1,095.4
October	4,125.5	4,859.0	875.3	1,233.8
November	4,504.3	4,697.0	994.1	1,168.2
December	4,539.2	4,543.4	1,004.0	1,227.0
Total	50,560.7	53,170.7	10,459.4	13,441.6

In December 48 estates (planted area 90,082 acres) were in production out of a total of 54 oil palm estates (planted area 93,331 acres).

MALAYAN AGRICULTURAL EXPORTS, JULY-SEPTEMBER, 1950.

Product	Net Exports in Tons.			
	Year 1948	Year 1949	July-Sept. 1949	July-Sept. 1950
Arecanuts	6,043	5,607	841 *	1,363
Coconuts fresh † ‡	44,887 †	21,971 †	8,145 †	2,288 †
Coconut oil ‡	45,245	60,504	20,927	13,957
Copra ‡	28,625 *	24,424 *	6,965 *	4,941
Copra cake	12,176 *	27,643 *	6,376 *	8,482 *
Gambier, all kinds	286	293	73	1
Palm Kernels	6,462	8,744	1,916	2,690
Palm Oil	46,821	55,211	13,230	17,865
Pineapples, canned	4,073	8,130	2,509	3,637
Rubber ¶	696,978 ¶	670,257 ¶	171,778 ¶	186,954
Sago,—flour	16,946 *	1,476	1,636 *	3,928
„ —pearl	19,084	3,477	464	503
„ —raw	6,667 *	1,317 *	21 *	5,591 *
Tapioca,—flake	304	737	160	373
„ —flour	1,999 *	278 *	172	800 *
„ —pearl	14,263	12,345	2,609	3,815
Derris	80	48	24	224
‡ Copra equivalent	45,795	74,334	27,204	27,667

¶ production (Federation of Malaya). † hundreds in number. * net imports.

FEDERATION OF MALAYA RUBBER PRODUCTION.

(In long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1949	1950	1949	1950	1949	1950
January	36,397	35,237	24,052	26,440	60,449	61,677
February	27,593	27,297	17,450	22,645	45,043	49,942
March	33,616	27,789	20,309	21,688	53,925	49,477
			14,113 †	476 †	14,113 †	476 †
April	28,142	26,667	16,744	22,409	44,886	49,076
May	33,570	30,870	18,499	25,898	52,069	56,768
June	32,921	31,196	18,683	23,169 ‡	51,604	54,365 ‡
			2,705 †		2,705 †	
July	35,751	34,547	20,137	30,947	55,888	65,494
August	36,658	33,316	20,504	29,307	57,162	62,623
September	33,828	30,323	24,900 *	28,514	58,728 *	58,837
				5,924 †		5,924 †
October	30,788	32,256	20,096	29,468	50,884	61,724
November	35,169	30,138	23,825	27,241	58,994	57,379
December	35,576	36,217	23,977	31,441	59,553	67,658
			4,254 †	9,388 †	4,254 †	9,388 †
Total	400,009	375,853	270,248	328,038	670,257	703,891
Total 1948	402,907		294,071		696,978	

Smallholding production is estimated from purchases reported by dealers.

† Quarterly adjustment.

* Includes quarterly adjustment (deduction of 822 tons).

‡ Includes quarterly adjustment (deduction of 3,370 tons).

FEDERATION OF MALAYA

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE.

(in tons)

Month	Copra Production						Coconut Oil Production		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1949	1950	1949	1950	1949	1950	1949	1950	1949	1950
January	2,476	2,577	7,406	7,765	9,882	10,342	4,727	5,501	3,245	3,634
February	2,605	2,662	5,544	6,868	8,149	9,530	4,429	4,831	3,027	3,182
March	2,644	3,064	4,981	7,062	7,625	10,126	4,638	5,774	3,211	3,798
April	2,755	3,002	6,203	7,367	8,958	10,369	4,832	4,847	3,325	3,201
May	3,039	3,424	5,884	10,160	8,923	13,584	4,995	6,507	3,437	4,341
June	3,500	3,761	6,723	9,109	10,223	12,870	5,607	6,373	3,756	4,176
July	3,838	3,767	6,915	9,158	10,753	12,925	5,710	5,962	3,870	3,938
August	3,867	3,580	8,676	9,916	12,543	13,496	5,671	6,315	3,858	4,222
September	3,651	3,581	9,256	12,593	12,907	16,174	6,282	6,503	4,190	4,168
October	2,778	3,390	7,745	11,567	10,523	14,957	5,440	7,320	3,711	4,805
November	3,035	2,807	9,332	10,239	12,367	13,046	5,736	6,312	3,871	4,101
December	2,769	2,997	7,315	9,062	10,084	12,059	5,631	6,555	3,799	4,253
Total	36,957	38,612	85,980	110,866	122,937	149,472	63,698	72,800	43,300	47,819

Notes:—1. The above statistics are compiled and published by the Registrar of Statistics, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

METEOROLOGICAL SUMMARY, MALAYA, OCTOBER, 1950

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	mm.	ins.						hrs.	hrs.	
Ipoh, Perak	89.7	71.8	80.7	93	70	86	74			9.43	239.5	1.83	19	17			1	173.40	5.59	
Port Swettenham, Selangor	88.3	72.5	80.4	92	70	82	75	85.0	85.7	7.87	199.9	1.97	20	19	3			167.50	5.40	
Kuala Lumpur, Selangor	86.3	72.2	80.3	93	70	83	74			10.93	277.6	1.62	18	17	8	2				
Sitiawan, Perak	88.4	72.0	80.2	92	70	84	94	84.0		8.14	206.8	1.26	18	17	6	1		170.35	5.49	
Kuala Lipis, Pahang	88.0	71.3	79.7	92	69	80	73	83.6	84.1	8.78	223.0	1.64	20	16	3	30		142.10	4.74	
Kuantan, Pahang	88.6	71.4	79.7	92	68	81	74			8.81	223.8	1.92	18	15	3	12		151.05	4.87	
Temerloh, Pahang	89.3	71.1	80.2	94	70	83	73			6.90	175.3	1.95	9	8	1	2		151.20	4.88	
Bayan Lepas, Penang	85.7	73.8	79.7	90	71	80	77			12.86	326.6	2.98	26	19	4			147.45	4.76	
Malacca	85.0	73.3	79.1	87	71	83	76			7.73	196.3	2.43	16	14	2			195.95	6.32	
Mersing, Johore	85.9	71.5	78.7	90	70	78	74			8.94	227.1	3.66	18	14	1		1	152.85	4.93	
Alor Star, Kedah	85.6	72.8	79.2	89	71	80	75			13.25	336.6	3.28	21	20	2			153.40	4.95	
Kota Bharu, Kelantan	86.2	73.6	79.9	89	72	78	76	83.8		15.18	385.6	2.87	21	18	1	2		184.00	5.93	
K. Trengganu, Trengganu	86.4	72.3	79.3	89	70	80	74			10.90	276.9	2.19	22	19	7	1	1	184.55	5.95	
Kallang Aerodrome (S'pore)	85.9	74.2	80.1	89	72	79	79			10.03	254.8	2.27	20	18	7			160.55	5.18	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	73.5	61.6	67.5	77	59	68	64	71.6		10.54	267.7	1.93	20	17	1	5		138.95	4.48	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	74.5	56.2	65.3	75	52	69	59	69.3	70.6	9.82	249.4	1.51	26	23		1		126.85	4.09	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, NOVEMBER, 1950

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall									Bright Sunshine		
	Means of			Absolute Extremes									Number of days								
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more		Total	Daily Mean	Per cent.
										ins.	mm.	ins.							hrs.	hrs.	
Ipoh, Perak	88.3	71.8	80.1	93	69	84	74			10.66	270.8	1.70	23	18	7	1			143.95	4.80	
Port Swettenham, Selangor	86.2	72.1	79.1	90	70	81	74	84.2	85.6	16.54	420.1	4.94	22	20	1				131.80	4.39	
Kuala Lumpur, Selangor	87.8	71.7	79.7	93	69	82	73			8.42	213.9	1.48	25	23	2	8					
Sitiawan, Perak	87.0	72.1	79.5	90	70	78	74	83.2		8.67	220.2	2.66	12	12	1	3			136.05	4.53	
Kuala Lipis, Pahang	86.0	70.8	78.4	91	69	79	72	82.8	83.6	7.55	191.8	1.17	20	17	1	28			134.75	4.49	
Kuantan, Pahang	86.2	71.4	78.8	90	69	76	74			14.10	358.1	1.95	22	20	3	7			111.70	3.72	
Temerloh, Pahang	88.0	71.2	79.6	92	70	80	72			14.05	356.9	4.10	19	19	5	1			138.70	4.62	
Bayan Lepas, Penang	85.5	72.9	79.2	89	71	78	75			12.50	317.5	3.02	19	18	5			2	136.55	4.55	
Malacca	84.1	72.8	78.4	86	71	80	74			10.98	278.9	2.60	21	16					136.20	4.54	
Mersing, Johore	85.1	79.1	78.5	89	71	78	73			10.83	275.1	1.03	22	19	1				131.70	4.39	
Alor Star, Kedah	85.4	72.1	78.7	90	71	76	74			9.87	250.7	1.53	22	20	1	1			138.80	4.63	
Kota Bharu, Kelantan																					
K. Trengganu, Trengganu	81.8	72.1	76.9	87	71	73	74			29.02	737.1	8.54	23	21		3			99.85	3.33	
Kallang Aerodrome (S'pore)	86.8	73.6	80.2	90	71	82	75			12.63	320.8	2.31	23	18	6				127.15	4.24	
HILL STATIONS.																					
Fraser's Hill, Pahang 4268 ft.	72.0	61.1	66.5	75	60	67	62	70.7		14.27	362.5	2.21	26	23	3	11			94.15	3.14	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.																					

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, DECEMBER, 1950

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F			Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										ins.	mm.	ins.						hrs.	hrs.	
Ipoh, Perak	89.3	71.1	80.2	92	67	85	73			7.17	182.1	3.67	12	9	4			176.10	5.68	
Port Swettenham, Selangor	87.8	71.5	79.7	91	68	83	74	83.2	84.8	11.35		2.47	20	17	4	1		157.75	5.09	
Kuala Lumpur, Selangor	88.2	71.1	79.7	92	69	84	73			9.72	246.9	1.86	14	11	3	11				
Sitiawan, Perak	83.8	71.5	79.9	91	69	85	73			4.17	105.9	1.60	18	13	3	2		179.20	5.78	
Kuala Lipis, Pahang	84.1	70.4	77.3	90	68	79	72	81.6	82.8	5.86	148.8	0.92	17	14		21		116.65	3.76	
Kuantan, Pahang	84.0	70.8	77.4	89	67	76	73			11.84	300.7	1.77	27	22	-	1		94.80	3.06	
Temerloh, Pahang																				
Bayan Lepas, Penang	87.3	73.8	80.5	90	71	83	77			4.28	108.7	1.36	7	6	1			230.60	7.44	
Malacca	85.0	72.3	78.7	89	70	77	74			4.97	126.2	1.79	16	13				181.20	5.85	
Mersing, Johore	81.6	72.3	76.9	87	70	75	75			30.05	763.3	4.12	28	27			5	106.40	3.43	
Alor Star, Kedah	86.8	70.7	78.7	89	68	81	73			1.72	43.7	0.54	10	5		1		189.75	6.12	
Kota Bharu, Kelantan	82.6	73.2	77.9	85	71	77	77			22.75	577.9	7.43	25	15				133.90	4.32	
K. Trengganu, Trengganu	81.8	72.4	77.1	86	70	76	75			23.13	587.5	4.72	26	22	1		1	101.35	3.27	
Kallang Aerodrome (S'pore)	85.2	73.2	71.3	91	71	76	74			7.34	186.4	1.37	22	17	4			122.85	3.96	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	68.9	59.7	64.3	77	58	63	62	68.9	70.3	9.58	243.3	1.28	25	23		23		84.00	2.71	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.																				

Compiled from Returns supplied by the Malayan Meteorological Service.